

## HERNIA

# HERNIA

Anatomy, Etiology, Symptoms, Diagnosis, Differential  
Diagnosis, Prognosis, and Treatment

BY

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THIRD EDITION

ENLARGED AND THOROUGHLY REVISED

*With Three Hundred Twenty-Three Illustrations*

By

HELEN LORRAINE

WILLARD C SHEPARD

RALPH SWEET



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## PREFACE TO THIRD EDITION

The rapid advances made in the surgical treatment of hernia in the past few years have created a need for a third edition of this work which is indeed gratifying

Each chapter has been thoroughly revised, important additions have been made and there have been some deletions of operations that are not in general use. The book has been completely revised and the type entirely reset. Text and illustrations have been planned so that they will be most helpful for quick reference. This necessitates some repetition which is unavoidable. The bibliography has been brought up to date.

New chapters have been prepared covering complications of hernia: internal supravescical hernia, epigastric hernia, hernia into the broad ligament, industrial hernia and recurrent inguinal hernia. The latter subject presents certain special problems which heretofore have been given little or no attention in surgical monographs.

Tho Cooper's ligament operation is described accompanied by excellent illustrations. The popular operation of Babcock is given in detail since he has been a pioneer in the successful use of fine wire sutures. Harrington's operation for diaphragmatic hernia is described and illustrated. New observations have been added on early rising after operation, suture materials, embolism and thrombosis, preoperative and postoperative treatment, as well as new statistics on the rarer types of hernia. The latter were secured by private correspondence with surgeons as well as a review of the hernia literature under various titles.

Many beautiful new illustrations have been added, fine drawings by the accomplished artists Miss Helen Lorraine and Mr. Ralph Sweet, who spared neither skill nor time in preparing them.

It may be thought that too much attention is devoted to the nonoperative treatment. The indications and limitations for the ambulatory method are now fairly well known. Disappointing results followed the indiscriminate and widespread use of strong sclerosing solutions in the hands of the inexperienced. Because the method requires more time than does operation to effect a cure and because of the frequent lack of cooperation on the part of the patient, it is seldom suited to the large industrial hernia. Experience has shown that the method has a definite field in carefully selected small hernias in the physically handicapped, and in extreme old age. Infants and children respond to the treatment more promptly than do adults.

My thanks are due to Professor Oscar Ivanissevich, Argentine Ambassador to the United States for helpful suggestions; to the personnel of the Lane Medical Library, to Miss Hazel Granger and staff of the Los Angeles County Medical Library, to Mrs. Marjorie Hutchins Moore, Librarian of the American Medical Association Library, to Miss Ella Salmonsén of the John Crerar

Library to Mr Wyllis F Wright librarian of the Army Medical Library to my secretary Miss Trice M Paulist for her painstaking typing of the manuscript, and to the surgeons of North and South America who have kindly cooperated by sending suggestions to improve the technique as well as new statistics

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## PREFACE TO SECOND EDITION

The adoption of the modern injection method for the treatment of certain types of reducible hernia by many industrial corporations insurance companies and state industrial commissions necessitates the revision of this book Experience has convinced me of the value of this treatment and of its far reaching economic importance to industry

Much of the historical material has been omitted from the text and the description of many operations for hernia have been deleted because these procedures are not now in general use being simply of historic interest in the development of hernia surgery Emphasis has been placed on the original Halsted operation for inguinal hernia by the silk technique to conform to present day practice which is replacing fascia lata transplant in certain cases of large and recurrent inguinal hernias

The medicolegal chapter has been rewritten to embrace the latest opinions of the insurance carriers and the rulings of the state industrial commissions

All the new drawings have been made by Mr W C Shepard My thanks are due the personnel of the Los Angeles County Medical Library especially to Mrs Mary E Irish the librarian and to Miss Hazel Granger for their many suggestions and courtesies to my secretary Miss Emilié Murceaux for her painstaking work in typing the manuscript and to my publishers for their constant helpfulness and consideration

LEIGH F WATSON

Los Angeles Calif

## PREFACE TO FIRST EDITION

The object of this book is to present within reasonable space the most important features of the anatomy etiology symptoms diagnosis differential diagnosis and prognosis of hernia together with the best operative technique of modern surgeons

A brief historical sketch has been incorporated in the more important chapters More space has been devoted to the anatomy than is usual in works on hernia in order to have the material accessible and to render unnecessary a search through the more exhaustive treatises devoted exclusively to anatomy

During the preparation of this volume every source of information has been studiously sought and a great amount of literature has been accumulated



To consult all of this has been no small undertaking, but thanks to the facilities afforded by the John Crerar Library, where almost all of the reference work has been done, this task has been rendered comparatively easy.

The operations for hernia are legion and it is impossible to give all of them in a one volume book, consequently some good ones have been omitted. The author has adhered to the plan of giving in detail the technique of the operation he uses for each variety of hernia. Other methods that are less generally used, but invaluable in certain cases, are outlined briefly.

The bibliography has been selected very carefully and with the hope that the original articles will be consulted, a majority of these contain exhaustive bibliographies.

In order to avoid repetition and to save space, cross references have been used freely and the reader is urged to consult the index.

All the drawings have been made specially for this work by Mr W C Shepard, whose painstaking efforts and hearty cooperation have made it possible to present the subject from a new point of view, and also to combine the anatomical details with the operative technique in the same drawings, thus greatly increasing their value.

The author takes pleasure in acknowledging his obligation to the many physicians at home and abroad who have been most kind in answering letters of inquiry.

His thanks are also due to Dr W W Watkins, for advice on roentgen ray technique, to Mr Robert J Folome and to Mr Hendrik Folome for suggestions on the medicolegal chapter, to Dr L J Mitchell and Mr William Whitford for editorial suggestions, to Miss May Whitford for her excellent work in typing the manuscript, to Mr W A Brennan and Miss Florence Carpenter for assistance in translating, to the members of the staff of the Surgeon General's Library for their many kindnesses, to the entire personnel of the John Crerar Library, and especially to Mr J C Bay and Miss Ella Salmonsens for their many helpful suggestions and courtesies, and to the publishers for their cheerful cooperation during the four years that the book has been in preparation.

LEON F WATSON

Chicago, Ill

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**HERNIA**

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## CHAPTER I

### HISTORICAL INTRODUCTION

*"No great and perfect work is ever accomplished at a single effort, or receives its final polish from one instrument" (Galen)*

We are most of us busy practitioners and I often wonder whether we are mindful of what has been accomplished by our predecessors and if we sometimes pause at the historical mileposts established by those who have labored so diligently and accomplished so much under difficulties of which we have no conception.

Hernia is undoubtedly as old as the history of man and while no records are extant it was probably treated by primitive man with the simple measures at hand, guided by his instinct. As civilization and knowledge increased reducible hernia was retained by a bandage or girdle and strangulated hernia was treated by such palliative measures as a light diet, rest, purgation and the application of cool water which was known to be more efficacious than warm water. Massage was known and taxis was employed being seldom gentle. Reduction was often aided by partially inverting the patient—our modern Trendelenburg position.

Operation was never attempted for strangulated hernia as its causation was not understood. Astringent plasters were applied, bleeding was practiced and wounds were sutured or bandaged to hasten healing. Trephining of the skull was done in the early stone age. In primitive times knives were made of flint and they were used up into historic times by the Egyptians and the Jews. Surgery was veiled in mysticism and sorcery. If a patient lived the good spirit had triumphed; if he died the evil demon was the stronger.

The earliest historic records of surgery begin with the Sumerians in Mesopotamia (about 4000 B.C.) who were conquered in turn by the Semites, Babylonians and Assyrians with the result that each added something real or fanciful to the development of medicine. Diseases were classified according to symptoms. The blood was believed to be the foundation of life; the arterial blood was called 'dry' blood and the venous blood was called 'night' blood.

Colic and abdominal pain were ascribed to phlegm, bile and wind. Herbs, honey and date syrup were mixed with milk and water and used internally and also externally as salves. Cupping, oil rubbing, hot baths and cold applications were used. However, any treatment was supposed to be ineffective unless combined with mystic incantations, and the application of various

amulets and charms to help drive out the evil spirit. Medicine and surgery were controlled by the temple priests who were the only practitioners.

The Babylonians were well versed in astronomy, consequently the various anatomical regions were placed under the control of the signs of the Zodiac and prognosis was made from astrology. The number 7 was considered unlucky and patients were not treated on any day that could be divided by 7.

The earliest records of physicians' fees and the regulation of the practice of surgery are found in the Code of Hammurabi (2200 B C) in which it is stated 'If a physician cause a severe operating wound with a bronze operating knife and cure the patient or if he open a tumor and save his eye he shall have ten shekels of silver.' However if the patient died the physician had his hands cut off. It might be mentioned that the bronze knives of this ancient period would take an edge equal to the best steel.

When a person was ill the custom of the Babylonians was to lay him in the public square where the passers by could talk to him and if they had ever had his disease or knew of any one who had suffered from it they were to give him advice as to what to do. No one was allowed to pass the sick man without asking him about his ailment (Herodotus).

The medical and surgical history of ancient Egypt goes back to the time of the pyramids about 3000 B C. As Neuburger remarks 'Thanks to the labors of the past century thanks to the desert sand and the almost rainless climate of Egypt which greatly assist to preserve the hoary remains of a past civilization we are far better able to review its development than in the case of less remote Greece and Rome.' The recent translation of the Edwin Smith surgical papyrus by Breasted has shed new light on the anatomy and surgery of the ancients. Eisberg states that this papyrus the oldest milestone yet discovered shows that medicine and surgery were cultivated 5000 years ago and gives the earliest reference to sutures and wound closure. The art of medicine and surgery in Egypt reached its zenith about 2000 B C. The Egyptians made improvements in the surgery of the Babylonians. They used bronze operating knives forceps hooks and needles they tied true reef knots opened abscesses and packed the cavities with lint linen or cotton. They improved the bandage treatment of hernia and discovered enemata. The Egyptians excelled all the races of antiquity in hygiene.

The priests were the only physicians and medicine was taught in the temple schools. Toward the period of decline specialism appeared. There were those who treated abdominal diseases and others who treated affections of the head and teeth. Before extracting decayed teeth they filled them with lead so they would not break. They believed that strangulation of hernia was due to an accumulation of hardened feces. This was also the belief of the Jews and it is referred to in the Old Testament. This opinion was held later by Celsus and by most surgeons after him. It was not until the seventeenth century that Lavater finally dispelled it in his book 'De enteroperistole'.

Most of our knowledge of the medicine and surgery of ancient Egypt is derived from the Ebers and Brugsch papyri which were written between the sixteenth and fourteenth centuries B C. At the time of the arrival of the

first Greek travelers in 700 B C Egyptian medicine and surgery had begun its decline Dissection was allowed at Alexandria under the Ptolemies but after the Roman invasion it was abandoned because the Romans believed that contact with a corpse was profanation The Alexandrian Library was founded by Alexander the Great in 320 B C It was destined to be the principal medical center for one thousand years and contained 500 000 volumes when it was burned the first time Mark Antony restored it at the behest of Cleopatra by moving the library from Pergamos and so it remained undisturbed until finally destroyed in A D 640

The Greeks ancient patrons of the arts and sciences contributed to the improvement of surgery and excelled in diagnosis Apollo and his son Æsculapius were celebrated as surgeons and were reckoned among the gods Podalirius and Machaon sons of Æsculapius as well as Chiron the Centaur were also noted surgeons of ancient Greece but unfortunately the monuments and writings of those ages were long ago entirely effaced by the ravages of the elements and time Hippocrates, who was a descendant of Æsculapius and lived in the fourth century B C excelled all others in the study of medicine and surgery He collected the available knowledge of the time on disease and its treatment and added his own valuable commentaries In his writings as well as in the fragments left by his contemporaries Praxagoras of Cos and Cælius Aurelianus there are references to hernia Praxagoras is credited with practicing taxis for strangulated hernia

The progress of the Grecian surgeons stimulated the interest of the Egyptians and Romans Later in Greece Philoxenus Gorgonius Sostratus Herones the two Appollonii and Ammonius Alexandrinus and in Rome Tryphon Luelpistus and Meges were famous surgeons but their works are all lost We know of them only through the writings of Celsus The Romans never equaled the Greeks in medicine or surgery To Asclepiades who lived in the second century B C is due mainly the credit of bringing Greek medicine and surgery to Rome

The surgery of the ancients has come down to us especially in the writings of the famous Roman Celsus who lived in the first century A D He operated extensively on umbilical hernias and less frequently on the inguinal variety He described the transluency of hydroceles used ligatures for hemorrhages sutured wounds of the intestines and advised the inclusion of the peritoneum in closing the abdomen For inoperable nonstrangulated hernias he used the ancient *emplastrum contra rupturam* and kept the patient in bed for forty days His directions for bandaging umbilical hernia in children differ only slightly from the present day methods (See chapter on umbilical hernia) He described and practiced both ligation and excision of hernial sacs with suture of the opening He applied compression accompanied sometimes by astringents

Aretæus a Greek physician of the first century, wrote on hernia his methods of treatment being similar to those of Celsus Soranus of Ephesus who lived in the first and second centuries A D was the most famous obstetrician and gynecologist of antiquity and was the first to describe hernia of the ovary and tube

In passing it is interesting to note that another Roman of this time Vitruvius Pollo described the symptoms of lead poisoning from leaden aque duct pipes and also wrote that gonorrhea was due to the water in certain localities.

Galen the last of the famous Greek surgeons lived in the second century A.D. He studied in Alexandria and afterward went to Rome. He was an ardent vivisector and studied anatomy in monkeys. Because the tunica vaginalis is open in these animals he thought it was open in man and on this account was led into the error of believing that hernia was due to a rupture of the peritoneum. He described nearly every bone in the body. Dissections were generally abandoned after the time of Galen who represented the zenith of the surgery of antiquity and by the third century surgery began to decline. Galen's method of treating hernia was generally by ligating the sac at the superficial ring or below it. His belief that hernia was due to a peritoneal rupture was held by many well down into the Christian Era; however it was the opinion of Paulus Ægineta and those who followed him that hernias of slow formation were due to stretching of the peritoneum and that it was only in a sudden hernia that the peritoneum ruptured. Rhazes Lanfranc and Guy de Chauliac who came later apparently knew that in hernia there was no peritoneal rupture but the point was not fully established until proved by Ruysch's dissections at the end of the seventeenth century.

Oribasius a famous Greek physician of the fourth century studied in Alexandria later becoming physician to the Emperor Julian. His encyclopedia on medicine and surgery is one of the most complete that has survived. Aëtius a Greek physician of the fifth century wrote on surgery but like others of this decadent period his books were only a compilation of the works of the earlier Greek writers. He treated hernia by compression and astringents.

Paulus Ægineta a Greek physician and surgeon who practiced in Alexandria in the first half of the seventh century the time of the Arabian invasion represents the last of a long line of famous physicians and surgeons of this school of learning which existed for nearly 1000 years. Paulus wrote at length on surgery and his writings on hernia are quite extensive. He dwelt on the symptoms of hernia and indications for treatment especially by the use of the ligature. He operated for nonstrangulated hernia according to the method of Celsus often using the transverse abdominal incision.

During the tumultuous times of the fifth century when the ominous clouds of the Dark Ages cast their pall over all Europe and proud Rome suffering the common calamity fell before the northern barbarians medicine and surgery which had been under the influence of Grecian culture were compelled to seek refuge in the monasteries and the priests again as in ancient times became the physicians a condition that continued until the sixteenth century when medicine was finally separated from the church.

About A.D. 500 the Persians gave asylum to Greek knowledge and in turn passed it on to the conquering Arabs. The Arabic period began with the second destruction of the Alexandrian school in 640 by Omar the successor of Mahomet.

After their first fanaticism had spent itself, the Arabs acquired a thirst for knowledge from their contact with civilization and they became ardent patrons of the arts and sciences. They translated nearly all the extant medical literature of Greece into Arabic. Indeed it is to these translations that we have had to turn to supply us with some of the missing books of Hippocrates and other ancient works. Among the famous Arabian surgeons may be mentioned Rhazes (850-932) who described the suturing of wounds with the strings of a harp (entgut); Halak Abbas (994) who operated extensively for hernia; Avicenna (980-1037) who described the differential diagnosis of enterocele and omentocele by resuscitation; and Albucasis (1122) who closely followed the methods of Celsus. Terapion Avicenna and Albucasis treated hernia by cauterization after exposing the sac by incision.

The Arabian decline came in the west with the fall of Cordova (1236) before the attack of Ferdinand III of Castile and in the east with the Mongol invasion and the fall of Bagdad (1258). In the eleventh century with the decadence of Arabian medicine the leadership passed to the tireless progressive races of Europe. During the twelfth and thirteenth centuries governments became more stable. The dark clouds that had overshadowed all the sciences and kept medical and surgical knowledge at a standstill for nearly a thousand years gradually began to clear. Schools were established in different countries and medical teaching was actively revived. The school of Salerno was most famous and the school of Montpellier was next in importance. These institutions reached the height of their influence and power during the twelfth and thirteenth centuries. Other schools spring up in many cities notably in Bologna, Padua, Paris, Naples, Toulouse, Valencia and Oxford.

The most notable hernia surgeons of this time were Roger of Salerno (1210), Roland (1250), William of Salicet (1230), Theodorice in Bologna, Lanfranc (1315) in Paris and Guy de Chauliac of Montpellier.

During the twelfth and thirteenth centuries medical science and religion were closely associated. In Italy and France nearly all the surgeons were clerics. Surgery was not recognized as a distinct art by the universities until later, and generally surgical operations were delegated to barbers or herbalists. In this transitional age there were all varieties of charlatans—hernialists, cutters for stone, bleeders, operators for entruet, etc.

Near the end of the transitional age came the master surgeon Guy de Chauliac in the fourteenth century. He studied in Montpellier, Paris and Bologna. His great work on surgery was published in 1363. Unlike most surgeons of those days he was not satisfied to turn his work over to barbers and herbalists but did the operating himself. He was a student of anatomy and was the first to distinguish umbilical from inguinal and femoral hernias. Among the medieval surgeons Guy de Chauliac alone appears to have been aware that hernia may occur in the thigh; after his writings it is not mentioned again until Nicholas LeQuin referred to it in 1665. Guy de Chauliac refers to it in his *Chirurgia Magna* and in the same work he differentiates ventral from umbilical hernia with which it was previously confused. He revised Celsus

method of laying the hernial sac bare and ligating it. He practiced excision of the sac with suture, which was also advocated by Bertrandi, Lanfranc and others.

The Age of the Renaissance (fourteenth to sixteenth centuries), the period of transition between medieval and modern times, marked phenomenal progress in all arts and sciences. In the sixteenth century decided progress was made in surgery, owing to the gradual lifting of the ban on dissection and to the separation of medicine from the priesthood which was completed in this century. Among the notable events in the history of hernia are Pol's report of the first case of hernia of the uterus, Fallopius described the fallopian tube, Vesalius described the appendix and Vidus Vidius named it, Plater reported the first case of bladder hernia, Paré described diaphragmatic hernia, Fabricius Hildanus wrote on partial enterocele and Roussetus described the operation for strangulated hernia which was later improved and popularized by Pierre Franco. To this period also belongs the "royal stitch" practiced by Fabricius ab Aquapendente and the *punctum aurium* of Ambroise Paré. These were methods of snaring the hernial sac with wire and separating it from the cord (inguinal hernia) so as to ligate the sac alone. Up to this time there had been no change in the treatment of strangulated hernia for almost twenty centuries—since the time of Hippocrates—its nature not being understood until the publication of Lavater's work already referred to.

The seventeenth century found an increased interest in anatomy and surgery. Sennertus reported the second case of hernia of the pregnant uterus. Since the second case of bladder hernia, Lavater recorded a case of hernia of the ovary and tube and described the mechanism of partial enterocele. Ruysch suggested the possibility of hernia of Meckel's diverticulum and Barthette Verheyen, Lowe and Scultetus wrote on the different varieties of hernia. Dionis advised dividing the external ring in strangulated hernia. Although operation for strangulation was general at this time the theories of the ancients as to the cause of strangulation were still prevalent. Lavater's book appeared in 1691. The nonoperative treatment in vogue at this time in Denmark and in some other countries was to keep the patient in bed for a period of six to twelve months. Many cures were reported following this procedure.

With the eighteenth century came an awakening in the study of anatomy and surgery, and a final breaking away from the beliefs and practices of the ancients. Littre and Méry observed cases of hernia of Meckel's diverticulum, the difficulties of diagnosis in diaphragmatic hernia were pointed out by Stehilinus, the duodenal fossae were described by Hensing, Haller and Bordenave, de Garengot described hernia of the appendix and hernia through the linea alba and Gunz Divoux, Arnaud and Veidier made extensive studies of bladder hernia. Petit said of large hernias that had long been irreducible that they "had lost their right of domicile." Gimbernat described the ligament that bears his name, and originated a new and safer operation for strangulated hernia. Mauchart wrote on the anatomy of femoral hernia.

Papen and Smellie observed perineal hernia in women. Le Dran wrote on hernia in the linea semilunaris, partial enterocele and femoral reduction.

*en misse*; La Chausse described ventral hernia, and De Gouey reported the second case of hernia of the fallopian tube alone. Haller and Verdier reported cases of sciatic hernia of the bladder. Arnaud, Pott, Sharp, Monro, Richter and Camper wrote important treatises on hernia.

A vast amount of literature has appeared on the operative treatment of hernia. Nearly two centuries ago, George Arnaud, the Parisian surgeon, published his treatise on hernia and, in his preface, remarked that he planned to publish a work embracing all that had been written on hernia. In the libraries of Paris alone, he transcribed 4,000 pages of writings on hernia before he gave up his ambitious plan.

In the eighteenth century castration was so frequently performed during hernia operations that official edicts were issued in many countries forbidding the removal of the testis. By the middle of the eighteenth century, operations for strangulated hernia were advocated by Petit, de Gareugeot, Le Dran, Richter, Heister, and others.

The operation for nonstrangulated hernia by incision of the sac was followed by such a high mortality that all operative treatment had been generally abandoned at the beginning of the nineteenth century by such eminent surgeons as Cooper, Pott, Scarpa, Boyer, and others. This condition of affairs stimulated the truss industry, and the mechanical treatment of reducible hernia flourished.

Langenbeek, in the first half of the nineteenth century, was one of the few surgeons who had the courage to remove the sac. As late as 1838, Lawrence pointed out the serious complications that followed interference with it. Pancoast, in 1844, injected tincture of iodine into the sac. Velpeau opened the sac and applied the iodine direct.

Bryant, in 1861, stated that the mortality of strangulated hernia was 22 per cent when the sac was not opened and 60 per cent when it was opened. McGill, in 1883, and Rabagliati, in 1884, found that the mortality rate was lower when the sac was excised than when it was left in situ.

With the beginning of the nineteenth century appeared the classic monographs of Cooper and Scarpa, and the dawn of the modern era in the surgery of hernia.

The ancients attempted to suture the divided ends of intestine in certain cases of gangrene or accidental rupture, Celsus observed that the best results followed stitching of the large intestine. As early as the thirteenth century, devices were used to unite the ends of the intestine. The Four Masters employed the trachea of an animal, which was cut the proper length, and inserted it into each end of the divided intestine, and joined the ends of the intestines with sutures. Roger of Salerno and Theodorice used a cannula of elder, Watson made a cannula of fish glue, Scarpa made one from tallow, and Desault and Chopart used a varnished playing card. Randhor invaginated the upper end of the intestine into the lower end, united it with sutures, and returned the intestine to the abdominal cavity, the patient survived. Bichat in the last of the eighteenth century pointed out that mucous and



serous surfaces do not unite, and Lambert in 1825 described his method of suturing serous surfaces in contact.

The modern operative treatment for inguinal hernia dates from the introduction of antiseptic surgery in hernia by Lister in 1871, and the epoch making papers published by Marcy in 1881, Macewen in 1886, Bassini in 1889, Halsted in 1889, and McArthur in 1901. These surgeons were the first to advocate a free exposure of the sac and structures of the inguinal canal by open dissection, along with a plastic reconstruction of the deeper layers of the abdominal wall.

Marcy described his epoch making technique in a paper he read before the International Medical Congress in London in 1881. It revolutionized the treatment of hernia and eclipsed the countless methods that had been used with more or less questionable results up to that time. Marcy was known to his friends as "Herni O."

To digress for a moment, many years ago Marcy told me that while reading his paper he saw Bassini in the audience, he was listening intently, an expression of understanding about him that seemed to change to pleasant conjecture. He did not discuss the paper. Marcy had called the absorbable suture the feature of his technique and believed it was responsible for the exceptionally good results he was reporting which so interested Bassini. Bassini had instantly grasped the secret of Marcy's success and believed it lay more in the high ligation of the sac and restoration of the obliquity of the inguinal canal than in the absorbable suture. So, when he returned to Padua he adopted Marcy's technique, and in 1889 he reported the records of many patients treated by the "Bassini operation."

During the period between 1870 and 1900, the methods of treating hernia were revolutionized, and the open operations displaced the blind and uncertain procedures of the past, with the result that more progress was made in these thirty years than in all the centuries that had gone before.

With the general acceptance of the open operation, the two points of controversy at the turn of the century were the disposition of the sac and the procedure for the repair of the inguinal canal. At the present time argument centers on the merits of the various suture materials.

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## CHAPTER II

### GENERAL CONSIDERATIONS OF HERNIA

A hernia is a protrusion of any viscus or tissue through an abnormal opening in the cavity in which it is normally confined. While this definition applies to various forms of hernia, such as hernia cerebri, hernia of the lung, muscle hernia, hernia of the intestinal mucosa, cystocele, rectocele, etc., the protrusion of an abdominal viscus is so much more common than the extrusion of other viscera, that the unqualified term "hernia" is customarily used to designate hernia of the abdomen.

**Etymology**—The etymologic derivation of the word *hernia* is probably from the Greek word *ῥοις*, meaning a branch, or offshoot, which simply denotes the hernial projection. The ancients used the Latin word *hele* (Greek *ἥλη*) (a swelling), and combined it with a word which designated the contents of the swelling, such as *enterocele* for intestinal hernia, *epiplocele* for omental hernia; *omphalocele* for umbilical hernia, *cystocele* meaning bladder hernia, while the word *bulonocle* indicated the point of protrusion. The older writers called *enterocele*, *rancx intestinalis*; and *epiplocele*, *hernia zirbalis*. The oldest printed Latin editions of the Bible use the word *herniosus*, and Chaucer, in the fifteenth century, used the word *hernia*. The Greek words used to designate the varieties of hernia, strangulation, etc., are discussed at length by Albert.

**Rupture**—The term "rupture" is still more generally used by the laity than the word *hernia* to designate abdominal protrusions. The word *rupture* should be discarded, because it means breaking or tearing through of a protrusion through the muscles due to violence or traumatism. Celsus in the first century A.D., wrote that, "The peritoneum is liable to be ruptured from a blow, from holding in the breath too long or from carrying a great weight, and that, without injury to the integument itself."

We know that hernia is almost always due to a congenital defect, namely, an open funicular process of peritoneum or an abnormal size or malformation of a normal opening in the abdominal wall.

A true traumatic hernia or rupture may appear suddenly following injury or violence, such as a fall from a height, or a crushing injury, which causes great increase in intraabdominal tension.

**Nomenclature**—Abdominal hernias are designated according to the contents, location, condition and cause.

1 According to the hernial contents, such as hernia of the small intestine, large intestine, omentum, bladder, appendix, ureter, etc.

2 According to their location, namely, inguinal, femoral, umbilical, ventral, diaphragmatic, obturator, perineal, sciatic, etc. (Fig 1)

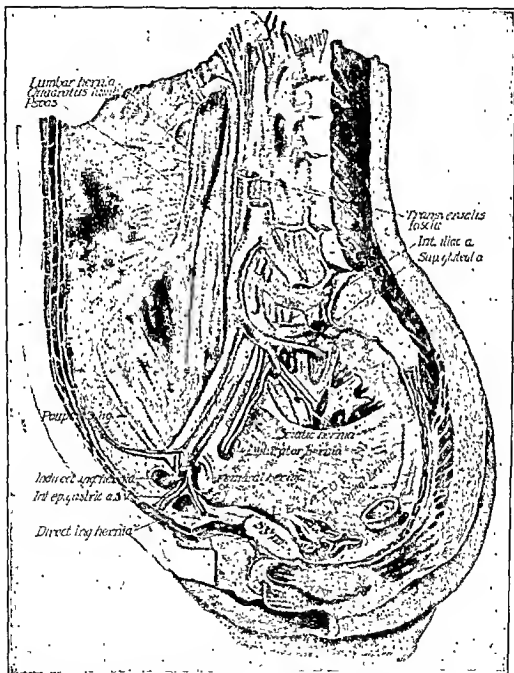


Fig. 1.—The internal openings in the abdominal and pelvic walls.

3 According to their condition, which is either reducible or irreducible, inflamed, strangulated, gangrenous, etc

4 According to the cause, which is congenital, required, traumatic, post operative, incisional, etc

**Frequency of Umbilical, Inguinal, and Femoral Hernia**—The inguinal variety constitutes 92 per cent of all hernias, femoral, 25 per cent, umbilical, 2 per cent, incisional ventral, 15 per cent, epigastric, 1 per cent, and all other hernias, 1 per cent. Inguinal hernia comprises 96 per cent of all hernias found in adolescent and adult men, and 50 per cent of the hernias that occur in adolescent and adult women.

Femoral hernias are nearly always found in women, 97 per cent in females and only about 3 per cent in males, however, it is only slightly more frequent in women who have not borne children than in men. It is rarely found in either sex under twenty years of age. Umbilical hernias usually occur in women, 75 per cent, compared to 25 per cent in men.

The statistics vary considerably from different clinics, depending on whether most of the patients examined were men, women or children. Femoral hernia is comparatively rare in men, frequent in women and seldom seen in young boys and girls.

In 8,655 cases of inguinal and femoral hernia in Italian soldiers reported by Perassi, 8,563 were inguinal and 92 femoral, a ratio of 94 to 1. On the other hand, Moore stated the ratio of hernias coming to operation were 114 inguinal to 1 femoral. He reported 113 patients with femoral hernia, of which 95 were women, and 18 were men.

## ANATOMY

**Congenital and Acquired Hernias**—All hernias are divided into two groups, congenital and acquired.

1 **Congenital hernia** is due to a developmental defect. The sac and contents may be present at birth or the contents may enter a preformed sac after birth. Congenital hernia is usually found in the inguinal region, where a hernia descends into a processus vaginalis testis that has failed to close.

2 In **acquired hernia** the sac is formed after birth, and the hernia passes through an opening in the muscular wall that closed normally at birth.

**Preformed or Congenital Sacs**—Until recently there has been considerable diversity of opinion on the subject of preformed sacs. The older writers usually classified all hernias appearing at birth as congenital, and those that developed after birth, as acquired.

I believe that probably in a great majority of the indirect inguinal hernias in the male, and almost all of those in the female the sac is preformed and consists of an open funicular process of peritoneum that was present at birth even though the hernia did not come down until adult life.

A man may go through life with an open processus vaginalis and never develop hernia. In the female a patent canal of Nuck is the usual cause of inguinal hernia.

In direct inguinal hernia the cord is separated from the sac or attached to it only loosely, while in indirect inguinal hernia it is usually very adherent to the sac the entire length of the inguinal canal. In indirect inguinal hernia in the female the round ligament is usually found in front of the sac and quite adherent to it.

**Changes in the Sac**—In small recent hernias the internal surface of the sac closely resembles the normal peritoneum of the abdomen. The peritoneal surface of a newly formed hernia is smooth shiny and slightly moist and consists of a thin connective tissue membrane poorly provided with blood vessels but with a good supply of sensory nerves.

The peritoneum is very sensitive to irritating influences such as inflammation the pressure of a truss and the friction of clothing. In old hernias the sac becomes thickened and dry and the delicate peritoneal nerve endings disappear. These sacs are often grayish in color and calcium deposits may be seen at different points. Weak portions of the sac often stretch and form diverticula and firm fibrous adhesions may develop between the sac and its contents. Old hernias usually present folds and wrinkles that run in a longitudinal direction.

In inguinal hernia the sac may be quite thick while in large umbilical and occasionally in femoral hernias it is so thin that the peristaltic movements of the intestines can be seen. In rare instances the sac wall may be the seat of tuberculosis or of malignant involvement.

**Types of Sac**—There is a wide variation in the shape of hernial sacs which is due to one or more of the following factors: the location of the hernia; the pressure exerted by the unyielding walls of the hernial canal or by structures outside of the sac; the effects of irritation within the sac or outside of it; and finally the change in shape that naturally follows the increase in size of the hernia.

The form of the sac is also influenced by the existence of diverticula or constrictions within the sac or outside of it. The sac may be unilocular or multilocular when longitudinal or transverse septa are present. A sac narrowed at two or more points is called a rosary sac. Hydrocele is often associated with inguinal hernial sacs and gives the latter an oval or pear shaped contour.

**Contents of the Sac**—Every abdominal organ has been found in the hernial sac. The viscera that normally have the greatest range of movement are found in the sac most often and in their order of frequency are: omentum, ileum, jejunum, sigmoid cecum, appendix, ascending colon, descending colon, bladder, ovary, tube, stomach, liver, etc.

The omentum usually enters the sac while the ring is still small and the small intestine descends after the opening has attained a fair size. The first foot of ileum above the ileocecal valve is the portion of small intestine most often found in the sac. It normally lies in close proximity to the internal inguinal and femoral rings and on account of the long mesentery it has more freedom of movement than any other part of the intestine.

**Relation of Omentum to Intestine in the Sac**—As first pointed out by LeDran, in 1731, the omentum enters the sac first and lies in front of the intestine, and for this reason, in employing taxis, it is important to reduce the posterior portion of the hernial contents first, and then the older omental contents that lie in the front of the sac. When omentum remains in the sac any length of time, it usually becomes adherent to the sac wall, it seldom adheres to the intestine unless inflammation develops, such as appendicitis or peritonitis in the hernial sac.

If the adhesions are extensive, especially around the neck of the sac, the hernia is often irreducible. In obese subjects, irreducibility is also favored by extensive fatty infiltration of the omentum and mesentery. Omentum is seldom found in the sac of inguinal and femoral hernia in young children. It hardly ever reaches as low as the pubes until after the second year of life. In adults and the aged, omentum is the most common hernial content.

The mesentery is short in young children, and, for this reason, only a small knuckle of intestine is found in the sac ordinarily. The length of the mesentery increases with age, and in adults and elderly subjects it is possible to draw down many loops of small intestine and sometimes large intestine to a point within the mouth of an inguinal or femoral hernia.

If a loop of intestine remains in the sac for some time, it undergoes certain changes on account of its abnormal position and the disturbances in its blood supply. It becomes lighter in color, its surface rougher than abdominal intestine, and its mesentery elongates and increases in size as the loop slides farther down into the enlarging sac. When only a portion of the wall of the intestine is in the sac, the hernia is termed a partial enterocele or Richter's hernia. When the sac contains a Meckel's diverticulum, the hernia is sometimes termed a Littre's hernia.

In sliding hernia (*hernie par glissement*), part of the large intestine, usually the sigmoid or cecum, enters the hernia by slipping with the peritoneum. The sac is present in front, but absent behind where the intestine and sac wall are closely adherent.

**Foreign Bodies in the Sac Contents**—Foreign bodies are sometimes found in a hernial sac. Lipomas, that have become detached, shriveled up and hardened, are most often found, they may undergo fibrous or calcareous changes and be free in the sac, or they may be enveloped by the sac contents. Other substances may be found in the sac, such as pins, needles, tacks, nails, shot, bits of glass, enamel, bones, etc., which have worked their way through the intestinal wall, although sharp pointed objects may enter the sac by penetrating its coverings or by migrating from another region of the body.

**Diseases of the Hernial Sac**—The hernial sac is often involved when the hernial contents are diseased, especially in case of tuberculosis and malignant growths. In 700 operations on children, McLennan found adrenal rests in the sac wall six times. Paghani found a rare type of fibromyoma in a hernial sac that had been diagnosed as a case of strangulated hernia.

**Diseases of the Hernial Contents**—The hernial contents are sometimes affected by tuberculosis, hydrocele, calcareous deposits, mesenteric and intes-

tinal cysts and benign and malignant growths. Tuberculosis and newgrowths usually involve the hernial sac early in the course of the disease. Echinococcus occasionally occurs in hernial sacs in patients living in tropical countries. The size of the swelling is variable; it is sometimes bilobed and the mass may be fluctuating or solid, depending on the tenseness of the contents. Devé stated that the hernial cyst is due to secondary infection of the peritoneum, usually from the liver. Thomas found a *Procepalus* larva in a hernial sac. Ludlow and Choy reported finding *Paragonimus westermanni* encysted in the omental contents of hernial sacs. Coley (B. L.) observed a case of filariasis of the cord and sac.

**Newgrowths**—Newgrowths involving the hernial contents and the sac are very rare. Arnaud in 1749 found a carcinoma of the intestine in a hernial sac. Gros Devaud in 1902 was able to collect only 14 cases of cancer in the hernial sac from the literature. In recent years cases have been reported by Baretz, Buxton, Carroll and Jacobs and Oppenheimer.

**Hemorrhage in the Hernial Sac**—Harry reported a rare complication of inguinal hernia. Without any unusual effort the hernia increased several times its normal size within twenty-four hours along with severe pain. At time of operation it measured 4 by 7 inches (10 by 17.5 cm). On incision the tumor was massive hemorrhage that came from a ruptured vein in the sigmoid mesocolon.

## ETIOLOGY OF HERNIA

**Predisposing Causes of Hernia**—The principal cause of hernia is undoubtedly the existence of a congenital sac. Other predisposing causes are congenital weakness of the hernial ring, heredity, age, sex, pregnancy, obesity, trauma and certain diseases.

**Heredity**—The transmission of congenital defects plays a small but definite role in the cause of hernia. Statistics show that about 25 per cent of the patients give a history of hernia in their parents or grandparents. Macready stated that a father having hernia tends to transmit a more marked predisposition to his sons than to his daughters and a mother transmits a greater predisposition to her daughters than to her sons, and she seems to have a tendency to transmit femoral hernia more than any other variety to children of both sexes. The tendency of hernial predisposition transmission from father to son and from mother to daughter may be explained partly by the fact that men are more subject to inguinal hernia and women to umbilical and femoral hernia by reason of conditions peculiar to each sex. I recall a patient with inguinal hernia associated with partially descended testis who said that both his father and his paternal grandfather had the same condition. In another instance I treated three boys in one family for inguinal hernia. Both parents and the maternal grandmother suffered from hernia. The influence of heredity on the development of hernia has been a subject for investigation by Montagu and by West.

While it is true that hernia is more common in some races than in others the fact is probably due more to poor physical development and laborious oc-



cupations than to hereditary influence. Frost estimated that 11.7 per cent of all railroad employees have some form of inguinal hernia.

Thurston and Connor have pointed out that in India hernia of the large intestine, especially cecal hernia, is common, owing to the effects of a bulky vegetarian diet. The intestine becomes larger and more mobile than is the case in meat eating races.

**Microscopical Examination of the Sac**—Microscopical examination of an indirect inguinal hernial sac shows that it consists of a thin lining of endothelium lying on a thick layer of dense fibrous tissue.

Hertzler remarked that one of the strongest evidences of the sac's being preformed is afforded by an examination of the connective tissue at the point of union of the sac and cord. Microscopical examination will show an interlacement of fibrils running parallel to the walls of the sac and continuing over the cord, but separated entirely from other surrounding tissue. In several hernias of less than five days' duration, microscopical examination showed that the union of the sac to the cord was made up of fully developed fibrous tissue free from cellular infiltration.

**Frequency of Hernia in Selective Service Registrants and War Workers**—Rowntree states that in 13,000,000 physical examinations of selective service registrants during World War II, the U. S. Army Medical service examiners found 229,000 hernias, or 5.7 per cent. He remarks that at first inguinal hernia patients were placed in a deferred classification, but when the hernia "pool" passed 200,000, the hernia patients were accepted and either operated on or given deferred classification. Rowntree points out that the Navy accepted hernia patients from the start of the war and insisted on an operation, however, the principal objection to the repair of hernias under compulsion was the psychic trauma, the result of painful scars and functional disability. In passing, I might remark that my records show many selective service registrants treated and cured by the injection method and accepted by the Army and Navy. Coyer and Widder stated that in 14,175 examinations of defense workers at a Naval supply depot, right inguinal hernias were more frequent than left hernias. Also, potential hernias were most frequent on the right side. They found that 3.71 per cent of white male workers between eighteen and fifty years of age in a Naval Supply depot had inguinal hernia, while the rate rose to 9.2 per cent in men over fifty years old.

**Age**—Age is an uncertain factor in the cause of hernia, especially in the inguinal and femoral varieties, when the sac is of congenital origin. Even when the hernia does not appear until adult life, the sac has undoubtedly been present since birth, and required only some unusual strain to force down the contents.

Inguinal hernia is most commonly seen in both males and females during the first year of life (15 per cent). From this time it diminishes in frequency until the age of adolescence, when it again increases, and remains a frequent occurrence during the active years—from fifteen to fifty years—when the percentage again falls. In females hernia is infrequent until adult life, and then

it occurs later than in males, and its frequency declines later—after sixty five years it is rare. Moolgavkar remarks that the testicle tends to draw down a dimple of preformed sac in males whereas in females the weight of the uterus pulling on the round ligament corrects any tendency to dimpling and may explain in part the small number of inguinal hernias in females.

In both males and females, right inguinal hernia is the most frequent variety throughout life. Femoral hernia occurs slightly earlier in females than in males and is most frequent during the active years of life in both sexes.

**Sex**—Inguinal hernia occurs about nine times more frequently in males than in females while femoral hernia occurs three times more often in females than in males. In 8655 cases of inguinal and femoral hernia in soldiers reported by Perassi 8563 were inguinal and 92 femoral. In 2769 cases collected by Malgaigne 220 (80 per cent) were in males and 564 (20 per cent) in females. In 21795 cases collected by Macready 18223 (84 per cent) were in males and 3572 (16 per cent) in females. In 70090 observed at the Hospital for Ruptured and Crippled (New York) and reported by Coley 53009 (75.7 per cent) were in males and 17081 (24.3 per cent) in females.

Aimentrout reported 37472 examinations of working men 1837 of them (4.9 per cent) had hernia. In 10000 cases of hernia studied by Berger 7433 (7.4 per cent) were in males and 2554 (2.6 per cent) were in females. He estimated that the proportion of ruptured males in the population was 1 to 149 while the proportion of females ruptured was 1 to 447. He found that in both sexes the lowest number of hernias occurred between the ages of ten and thirty five years and after thirty five the frequency gradually increased reaching its maximum in males at seventy and in females at sixty five.

Inguinal hernia is more common on the right side especially in males and the disproportion is most marked in infants and children.

#### RELATIVE FREQUENCY OF THE VARIETIES

(Eccles)	INGUINAL	FEMORAL	UMBILICAL
Males	96.33	2.53	1.14
Females	50.6	33.5	15.9
(Macready)			
Males	97.5	2.5	
Females	60.3	39.7	

**Relative Frequency of Inguinal and Femoral Hernia in the Two Sexes**—According to Macready inguinal and femoral hernia are divided between the sexes as follows

Female inguinal	85
Male inguinal	83.5
Female femoral	59
Male femoral	21
	<hr/> 100.0

**Double Hernia**—Double hernia occurs on both sides at the same time in 4.6 per cent of males and in 3.1 per cent of females who have hernia. It is usually inguinal and 48.9 per cent of the cases in males and 41.7 per cent of the cases in females develop during the first year of life. As life advances

single hernias become double in 36.6 per cent of males and in 23.3 per cent of females. The tendency to double inguinal hernia and double femoral hernia is greater in males than in females. Left inguinal and left femoral hernia in the same subject more often become double, than right inguinal and right femoral hernia.

**Obesity**—Obesity is an important predisposing cause of hernia in women. The fatty infiltration of the omentum and mesenteries and the accumulation of large quantities of fat in the anterior abdominal wall increase intraabdominal tension. This extra weight and strain result in a general relaxation and atony of the muscles in this region, causing them to separate at their weakest point, which is usually the umbilicus.

**Pregnancy**—The marked distention of the abdomen during pregnancy results in an atrophy of the muscles with a tendency for them to separate at the umbilicus. Increasing obesity usually follows repeated pregnancies, furnishing an additional influence.

**Deficient Musculature**—Deficient or poorly developed muscles or fascia are sometimes predisposing factors in certain varieties of hernia, especially in direct inguinal hernia, hernia through the linea alba, and lateral ventral hernia. In direct inguinal hernia the muscle development is defective at the weak spot in Hesselbach's triangle.

**Right Inguinal Hernia After Appendectomy**—It is well known that right inguinal hernia often appears after an operation for appendicitis. It is due to injury of the iliohypogastric nerve or failure to close the transversalis fascia properly at the time of the appendectomy. Surgical literature would lead one to believe the occurrence of right inguinal hernia is most unusual, but statistics prove the contrary to be the rule. Thieszen, in 1944, reported 31 patients who developed inguinal hernia following operations in the right lower quadrant.

I have seen 200 patients who developed inguinal hernia after an operation for appendicitis, in 173 the duration of the hernia was given.

TIME BETWEEN THE OPERATION FOR APPENDICITIS AND THE APPEARANCE OF THE HERNIA

UP TO		YEARS																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21-30	31-40	41-50
14	11	10	9	1	5	12	5	6	14	10		4		17		9		19		25	10	2

DURATION OF THE HERNIA THAT DEVELOPED AFTER AN OPERATION FOR APPENDICITIS

MONTHS						YEARS													
1		2		6		1		2		3-4		5-9		10-19		20-29		30-49	
R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
37	22	13	6	6	3	19	6	11	5	9	4	7	2	14	2	2	1	1	2

**Prolapse or Abnormal Length of the Mesentery**—The average length of the mesentery in adults is 6 to 7 inches (15 to 17.5 cm). It was formerly thought that a long mesentery was a predisposing factor to hernia, but with the present knowledge of congenital sacs, this idea has been abandoned.

**Other Predisposing Causes**—The following factors may also favor the occurrence of hernia: an increase in the bulk of abdominal viscera, such as enlargement of the liver or spleen, newgrowths, deposits of fat in the omentum and mesenteries, ascites, and certain occupations that necessitate a kneeling or stooping posture and relax the abdominal muscles and potential rings. In the aged, urethral obstruction or prostatic disease may be an aggravating factor. In rare instances, phimosis may be a predisposing cause in children. Altschule noted the frequency of hernia in patients with ascites and cirrhosis of the liver.

**Congenital Sacs**—At the present time the generally accepted cause of inguinal and femoral hernia is a preformed or congenital sac. Murray made postmortem examinations on 100 subjects who had no hernia during life, and found 21 potential or empty sacs, all femoral except one.

**Exciting Causes**—The principal exciting cause of hernia is an increase in intraabdominal tension, which may be due to straining, such as coughing, lifting, etc., or to external violence or trauma, such as a blow, a fall from a height or a crushing injury. It may be due also to any condition that diminishes the capacity of the abdominal cavity. Whooping cough is a common exciting cause of hernia in children. Bronchitis, the cough associated with tuberculosis, emphysema and asthma are occasionally exciting factors.

In 502 cases of umbilical hernia in adult females at the Hospital for Ruptured and Crippled (New York), and reported by Coley, the cause of the hernia was unknown in 204. In 195 it was attributed to pregnancy, in 83 to strain, in 8 to coughing, in 6 to a fall, in 3 to obesity, in 2 to ascites, and in one patient the hernia was congenital. In 4,780 cases of hernia in males, over fifteen years of age, the cause was unknown in 3,102. In 1,695 the development of hernia was ascribed to an exciting cause, in 1,015 of these it was attributed to lifting, or carrying a weight, in 150 to coughing or sneezing, in 123 to strain, in 89 to a fall, in 40 to a blow on the abdomen or groin, in 14 to local trauma, in 8 to a kick, and in 51 the hernia had been present since birth.

**Disability**—Nilson stated that an employee with a hernia is a potential hazard, and his efficiency is reduced 25 per cent.

**Traumatic Hernia**—The sudden occurrence of hernia following a blow or a crushing injury is very rare. The sudden appearance of the hernia is accompanied by pain, swelling, edema, and usually ecchymosis of the hernial coverings. The relation of hernia to industrial surgery is becoming more and more important. (This subject is discussed in the industrial chapter.)

**Artificial Hernia**—In some countries it is a common practice for youths who wish to escape military service to produce a hernia by stretching the external inguinal ring and enlarging the inguinal canal by means of a blunt pointed stick or other instrument or by digital dilatation. At the same time, violent sneezing is induced by inhaling snuff, and in two or three days the subject has a well developed hernia. Graser stated that these hernias can be distinguished easily from ordinary ones, because in the induced hernia the external ring is nearly always irregular, jagged and infiltrated with inflammation, and often there are unusual openings in the aponeurosis of the external oblique

A Russian writer, whose name I do not recall, reported the case of a young man who produced an artificial hydrocele by cutting the skin at a point on the scrotum, introducing a goose quill and blowing air into the subcutaneous tissues. He closed the skin aperture with a piece of putty.

### SYMPTOMS AND DIAGNOSIS OF HERNIA

From a clinical standpoint it is most convenient to classify hernias in general into the following varieties

- 1 Reducible
- 2 Irreducible
- 3 Inflamed
- 4 Obstructed
- 5 Strangulated

The diagnosis of reducible hernia is almost always easy but the other varieties may present unusual difficulties

**Reducible Hernia (Free Hernia)**—A reducible hernia is one in which the contents of the sac can be returned to the abdominal cavity. Almost every hernia is reducible in the beginning the contents returning to the abdomen spontaneously when the patient assumes a certain posture or when taxis is employed.

**1 Functional Symptoms**—A swelling is usually the first sign of hernia. The symptoms depend on the age of the patient, the location of the hernia, and its period of duration. It probably takes weeks or months for the ordinary hernia to become large enough to be noticed. The preformed sac is very small, usually no larger than a goose quill.

*(a) Premonitory Symptoms*—Some writers have attached importance to premonitory pains as a symptom of an impending hernia although these are too uncertain to be of much clinical value, I have occasionally seen children who complained of pain in the inguinal region for a few weeks previous to the appearance of the swelling, and it is not uncommon for recurrent hernias to cause the patient considerable pain and discomfort before a bulge at the internal ring can be detected.

*(b) Later Symptoms*—The symptoms of hernia differ in children and adults. In children the swelling may be over the umbilicus or in the groin, following whooping cough or some other exciting cause, or it may appear without any apparent reason. The hernia comes down when the child cries or when he is playing and while it is down the child is uncomfortable, restless and irritable. The hernia is nearly always easily reduced (I have known these little patients to stop playing lie down, reduce their hernia by pressure with the fingers, get up and return to play).

In adults pain is the symptom most commonly complained of. It is especially annoying while the hernia is small, before the hernial rings, canal and surrounding structures have become stretched. The pain and discomfort are usually worse after standing or walking for several hours. There are often

headache, digestive disturbances such as flatulence, colic and vomiting when the hernia is obstructed constipation is the rule and in hernia of the sigmoid it may be very marked. Pain is most often complained of when the viscera are descending into the sac, or when they are being reduced.

A patient involuntarily protects the side of the hernia by making pressure with his hand when coughing, sneezing or straining. If the bladder is involved there will be disturbances in miction and in rare instances micturition is accomplished in two stages. Koontz in an interesting review calls attention to the important symptoms that may accompany the various types of hernia.

**2 Physical Signs of Reducible Hernia—(a) Inspection**—By inspection the location of the tumor can be ascertained and its general shape noted. It may be oval, oblong, pear-shaped, pedunculated or pendulous. Any change in size when the patient stands up or lies down should be observed. When the sac wall is very thin and the hernia large the intestinal coils can be seen in outline. A hernia is often more easily seen than felt. Before looking for a small hernia the patient should be asked to strain or cough.

**(b) Palpation**—If the mass can be returned into the abdomen the diagnosis of hernia is usually positive. As the hernia is reduced it feels to the examiner like a solid or semi-solid doughy mass slipping through his fingers. If intestine is in the hernia a distinct gurgling can be heard and felt.

A definite impulse, a tapping impact on coughing is one of the most valuable signs of hernia and may be elicited if the examiner places his hand over the hernia or in the case of inguinal hernia with a large opening by inserting his finger in the inguinal canal. To explore the canal the index finger should be placed on the front and lower part of the testis and pushed upward invaginating the scrotum as it passes the external ring. By beginning the invagination low down on the scrotum the examining finger obtains the greatest freedom of movement in the inguinal canal.

The examiner should never under any circumstances dilate the inguinal canal in order to palpate the internal ring. This practice is to be condemned vigorously as it is a frequent cause of hernia. While intestine returns to the abdominal cavity with a gurgling sound omentum goes in noiselessly. When intestine and omentum are both in the sac the intestine reduces first and is followed by the omentum. When intestine is alone in the sac the last part of it goes in suddenly.

After the hernia is reduced it is usually possible for the examining finger to follow it up and determine the size and shape of the internal opening, the condition of the hernial canal and the development of the muscles and fascia that are available for repair.

**(c) Percussion**—If the note on percussion is tympanitic it is almost certain that one or more loops of intestine containing gas are in the hernia. If the note is dull it usually means that considerable omentum is in the sac, or if there is intestine it is empty or filled or else it contains solid contents. A dull note may also be elicited when the omentum overlies the intestine.

A dullness over a direct inguinal hernia should put the examiner on his guard for hernia of the bladder. Dullness over a scrotal hernia suggests a complicating hydrocele.

(d) *Auscultation*—The gurgling sound of a reducing intestinal hernia can be heard sometimes at a distance of several feet from the patient. An absence of gurgling means that the hernia is omental, that the intestine contains little or no gas, or that the internal ring is large in proportion to the size of the sac. Absence of peristaltic sounds in strangulated hernia is a grave sign and calls for immediate operative intervention.



Fig. 2.—A loop of sigmoid colon in a left inguinal hernia in a man seventy years old.

(e) *X ray*—In nonstrangulated hernia it is sometimes possible to determine the contents of the sac and to distinguish between large and small intestine by roentgen ray examination after an opaque meal, as suggested by Pirie Bálon and Barsony and others (Fig. 2). Marchetti diagnosed a sciatic hernia of the sigmoid before operation by roentgen ray examination.

(f) *Pneumoperitoneum*—The use of pneumoperitoneum as an aid in the diagnosis of difficult and obscure indirect inguinal hernia has been successfully employed by Ivanissevich and Martiarena.

**Hernia in Relation to General Health**—The ill effects of hernia on the health are well known, and the severity of the symptoms depends on the situation of the hernia and its contents. Some hernias give rise to considerable pain

especially hernias through the linea alba and obturator hernia. In certain instances especially in epigastric hernia the gastrointestinal symptoms are out of all proportion to the size of the tumor. The cure of the hernia not only improves the patient's general health such as overcoming constipation, headache, nervousness, etc., but certain neuroses as hysteria and neurasthenia often disappear. Myers and Zollinger have called attention to the fact that severe gastrointestinal symptoms accompany and often obscure the diagnosis of small inguinal hernia.

### DIFFERENTIAL DIAGNOSIS OF REDUCIBLE HERNIA

Reducible hernia is most frequently mistaken for hydrocele. Other diseases that may simulate hernia are lipoma, adenitis, varicocele, saphenous varix, cold abscess, cysts and newgrowths.

**1 Hydrocele**—Scrotal hernia is liable to be confused with hydrocele. In hydrocele there is no impulse on coughing, the tumor is not reducible, and on percussion the note is dull. There is an absence of digestive symptoms and pain in the inguinal region and the hydrocele is translucent. In hernia in infants and young children the intestinal wall is very thin and sometimes translucent, this point should always be remembered.

**2 Lipoma**—Hernia through the linea alba, small umbilical hernia and femoral hernia are to be differentiated from lipoma. Lipoma occurs most frequently in the linea alba above the umbilicus and is often adherent to a small peritoneal sac. A femoral lipoma is movable, gives no impulse on coughing, cannot be traced directly into the femoral canal and does not change size or position when the patient stands up or lies down.

**3 Adenitis**—Inguinal and femoral hernia are to be distinguished from adenitis. Subacute or chronic adenitis especially of tuberculous origin sometimes presents the greatest difficulty. Cases are on record in which a suppurating lymph gland overlay a strangulated femoral or obturator hernia. The history of reducibility in the early stage of the swelling may be the only symptom pointing to hernia.

**4 Varicocele**—Inguinal hernia must be distinguished from varicocele only in rare instances. In varicocele the tumor disappears when the patient lies down, even though the examining finger makes firm pressure at the external ring, and it reappears when the patient stands up, even when pressure is continued. Varicocele gives a characteristic thrill on coughing, like fluid being dashed against the fingers.

**5 Saphenous Varix**—Femoral hernia sometimes has to be differentiated from saphenous varix. Saphenous varix has the same signs that are found in varicocele. Zamoshchin has noted that a hard varicose nodule may simulate a strangulated femoral hernia.

**6 Cold Abscess**—Occasionally inguinal and femoral hernia must be distinguished from cold abscess. Cold abscess usually follows tuberculous osteitis of the vertebrae or one of the pelvic bones. When the abscess appears in the femoral region it resembles a femoral hernia in that it is reducible and has an impulse on coughing. However, unlike femoral hernia it



presents fluctuation and bimanual pressure shows that the external and internal swellings communicate and that fluctuation is easily transmitted from one to the other. Examination of the patient's back will generally disclose marked rigidity of the spine or osteitis of the vertebrae.

Cold abscess in the inguinal region may be due to tuberculosis of the pubic bones. The swelling is usually outside of the inguinal canal, there is no impulse on coughing and the inguinal canal is empty.

**7 Cysts**—Inguinal and femoral hernia are to be distinguished from cysts. A labial hernia may simulate a cyst of Bartholin's gland. In the latter condition the tumor is of slow growth, it is dull on percussion translucent and the inguinal canal is empty.

Sometimes hernia cannot be differentiated from cysts of the spermatic cord and hydrocele of the canal of Nuck if they are small and lie in the inguinal canal. If a portion of the hernial sac becomes shut off from its communication with the abdominal cavity a cyst is liable to form. If the sac is shut off at more than one point there may be multiple cysts. A rare case of torsion of a cyst of a hernial sac was recorded by Smith.

**8 Newgrowths**—In rare instances hernias must be distinguished from benign and malignant growths such as occasionally develop in the spermatic cord of an undescended testis or in the round ligament that lies in the inguinal canal.

**Formation of an Abscess Outside the Hernial Sac**—The formation of an abscess outside of the hernial sac is a rare complication and usually occurs in elderly patients who have had a reducible hernia of long standing. Following increasing pain and tenderness the hernia becomes irreducible with symptoms of inflammation. The symptoms are not so acute as when the inflammation is inside the hernial sac.

## PROGNOSIS OF REDUCIBLE HERNIA

The prognosis of untreated reducible hernia is always serious.

**Infants and Young Children**—While a majority of inguinal and umbilical hernias in infants (under two years of age) can be cured by mechanical treatment there is the danger that the hernia will slip by the truss and strangulate. However at this age strangulation is not common. While operation is advisable and recommended for infants over two months of age and young children if the hernia is very small it can often be cured by a few injections of a mild sclerosing solution without the necessity for hospitalization (see chapters on inguinal hernia in children and umbilical hernia).

**Older Children and Adults**—The radical operation is always to be recommended as the treatment when the hernia cannot be controlled by a truss or when the hernial opening does not decrease in size under palliative measures. In infants, children and adults the operation offers a good prospect of cure. The danger is very slight especially with local anesthesia and the percentage of recurrence is very low.

**The Aged.**—To those patients in the advanced years of life all surgical procedures carry a multitude of dangers, the principal ones perhaps, being the general anæsthetic and the confinement to bed.

Fortunately, the primary development of hernia in the aged is infrequent probably because these individuals avoid heavy labor in an effort to conserve their declining physical powers, consequently they are exempt from the usual causative factors of hernia that apply to the active years of life.

The possession of a small reducible hernia is apparently more of an asset than a handicap, unless it becomes strangulated it does not shorten the duration of life and it compels the individual to take care of himself, to avoid heavy work and exposure with their attending wear and tear on the body, which is the usual lot of the elderly individual who is sound.

The hernia of the aged is usually more difficult to control with a truss on account of the relaxation of the hernial rings. When operation is indicated the danger can be minimized by the use of local anæsthesia, and the period of confinement is shortened because recuperation is more prompt than after general anæsthesia.

### TREATMENT OF REDUCIBLE HERNIA

The treatment of reducible hernia may be mechanical or by operation or by injection.

**Mechanical Treatment.**—Mechanical treatment consists of reducing the hernia and keeping the contents retained in the abdominal cavity by means of a suitable bandage or properly fitting truss until the hernial opening closes spontaneously. The indications for mechanical treatment for the different varieties of hernia are considered in their respective chapters.

**Operative Treatment.**—Operative treatment of reducible hernia is to be advised when there is little prospect of a spontaneous cure when the truss cannot be tolerated and when it does not retain the hernia.

**Injection Treatment.**—(See chapter on injection treatment.)

### GENERAL PRINCIPLES OF OPERATIVE TREATMENT

**Sterilization of Dressings, Sponges, etc.**—The importance of properly sterilized dressings sponges sheets towels etc cannot be too strongly emphasized. Some good hospitals are occasionally careless in this respect.

**Sterilization of the Skin.**—As a rule the field of operation should be prepared twelve to twenty four hours before the operation. The skin should be scrubbed with soap and water using a soft bristled brush sponge or a gauze compress for a distance of several inches beyond the field of operation. If the region is covered with hair it should be shaved. A dry sterile dressing is applied and left on until the patient is on the operating table when it is removed and the skin painted with tincture of mercurin (stainless). Thus antiseptic is preferred because it does not stain the white canvas shoes generally worn while in the operating room.

In emergency operations the skin should be shaved, scrubbed thoroughly, dried, wiped off with benzoin or gasoline and finally a coat of iodine applied.

**Sterilization of Instruments**—It is the usual practice to sterilize noncutting surgical instruments by boiling them in a 1 per cent sodium carbonate or sodium bicarbonate solution. Instruments sterilized in this manner rust very easily, as the sodium carbonate or sodium bicarbonate does not combine with the carbon dioxide in the water, the carbon dioxide in the water causes the rusting. To prevent rusting, I boil the instruments in a  $\frac{1}{4}$  per cent solution of sodium hydroxide. The solution should be allowed to stand two minutes before putting in the instruments to allow the sodium hydroxide to combine with the carbon dioxide in the water.

Scissors, scalpels, needles, and other cutting instruments are best sterilized by soaking in phenol and rinsing off in alcohol just before use.

**Rubber Gloves**—Rubber gloves should always be used by the surgeon and assistants during hernia operations to prevent infection, thus lessening the danger of recurrence. Gloves can be boiled with the instruments or sterilized by dry air and they should never be used when they have even small holes in them.

**Dangers of Talcum Powder**—The harmful effects of talcum powder on gloves is now generally recognized as a cause of postoperative adhesions and complications. Its reaction on the tissues is progressive and permanent. Potassium bitartrate dusting powder is safe and harmless. Seelig and Verda advise using a nongelatinous starch powder. Borsorb powder is the best.

**Operating Gowns**—The operator, assistants and spectators should wear gowns. The surgeon and assistants should wear gowns with long sleeves so that the wrists will be covered by the wrists of the gloves.

**Caps and Face Masks**—The operator and assistants should always wear caps and gauze face masks covering the head and mouth in order to lessen the danger of infection. Before caps and masks came into general use it was not an uncommon thing to see dandruff fall into the wound and it was impossible for the operator or assistants to talk without particles of saliva being projected there also. For those who wear glasses it is a good plan to attach a piece of adhesive plaster to the upper edge of the mask covering the mouth and nose. The adhesive strip is attached to the cheeks just below the eyes and effectively prevents steaming of the glasses.

**Suture Material**—The selection of the proper suture material is one of the most important factors for insuring a smooth convalescence and a minimum danger of recurrence. I believe silk or cotton sutures should always be employed for all varieties of hernia operations. Silk which was introduced by Halsted has certain advantages over the cotton suture, because of its greater tensile strength and ease in handling.

We now know that catgut causes a reaction in the tissues which results in a slight fever and more or less wound tenderness and irritation, even in patients who do not possess an allergy to catgut. Early absorption of the animal suture increases the danger of wound infection and a recurrence of the hernia (see catgut allergy). There has been a steady shift among surgeons the world over

toward nonabsorbable silk and cotton sutures, as well as the more scientific placement of the stitches. Silk and cotton have a definite advantage over the absorbable materials because they remain in place in the tissues unabsorbed until the wound heals. The result is a smooth convalescence and lowering of the recurrence rate. The silk or cotton technique calls for the following: meticulous care in wound asepsis, gentleness in handling of the tissues, the selection of fine suture material, the careful ligation of bleeding points without including masses of fat or muscle along with the bleeding vessel, the approximation of structures without tension by means of interrupted sutures throughout. Catgut can be used when skin infection is present or in case of strangulation with intestinal resection when slow healing is a possibility.

In historical retrospect it is interesting to note that Elsberg, writing on the anatomy and surgery of the Edwin Smith Surgical Papyrus, observes that Breasted states this is the earliest reference to sutures or stitching. This papyrus is the oldest yet discovered, dates back 5,000 years, and advises that if a wound breaks or its stitches loosen, the edges are to be drawn together with linen strips coated with a sticky resin, much used for embalming at that time.

In the *Odyssey*, the strings of the old Greek harp are described as made from the twisted intestine of the sheep. While often used by the ancients for ligation of blood vessels, catgut is not mentioned as a suture for wounds until the time of Rhazes who practiced in Bagdad, A.D. 900. He also mentions its use by the Alexandrian School in Egypt. Aulus Celsus who lived in the twelfth century, mentioned the stitching together of wounds of the bowels with a fine thread from the twisted intestine of an animal.

Because all wounds suppurated, nonabsorbable suture material was generally employed until the introduction of antiseptic surgery by Lister. Antiseptic catgut was first used in the modern operation for hernia in 1871 by Marey, who was a pupil of Lister.

**Blood Vessel Suture**—For closing accidental wounds in blood vessels, the operator should always have very fine, straight needles (No. 16) convenient, and very fine thread (No. 00000 twist black silk). Both the needle and the thread should be sterilized in petroleum jelly.

If the cut is extensive, the method of suture devised by Horsley is to be recommended. Briefly, the steps are as follows. The wounded vessel is exposed, the blood stripped from it, and light clamps are applied above and below the cut. If the margins are ragged or bruised, they are trimmed with sharp scissors. If the transverse wound involves more than half of the circumference of the vessel, the latter is completely divided and united by end to end suture. The adventitia is trimmed away along the edges of the wound, the blood clots are removed, the edges of the wound and the intima washed with Locke's solution and smeared with sterile olive oil.

If the cut is parallel with the vessel, it is sutured with a cobbler's stitch, using fine straight needles (No. 16), and fine black silk, sterilized in petroleum jelly. The suturing is often facilitated by grasping the vessel with Horsley's curved blood vessel forceps. When the wound in the vessel is transverse, Horsley's suture staff is slipped beneath the vessel and the edges are approxi-

mated by placing a guy suture at each end of the wound. The tension of the staff is sufficient to evert the intima while the wound is closed with a cobbler's stitch. Care should be taken to secure the beginning of the suture line by taking a back stitch well beyond it.

When the vessel wound is inaccessible, it sometimes is necessary to place a long guy suture at each end of the wound and to close the opening with a continuous overhand stitch of black silk threaded in a very fine round full curved needle (No 16). This stitch permits more leakage from the needle holes than the cobbler's stitch, and also increases the danger of thrombosis.

**Suture Needles**—The needles ordinarily employed for hernia operations are the same as those used in any abdominal operation. For closing the peritoneum and transfixing the sac preliminary to ligation, a sharp pointed round full curved needle is very satisfactory. For the deep sutures in muscle and fascia, a heavy, round full curved needle is the best.

Some surgeons prefer a Hagedorn full curved needle for the deep sutures. Many use a blunt pointed full curved needle to lessen the danger of wounding the deep vessels in operations for inguinal and femoral hernia. De Garmo employed a full curved round cervix needle, with the point filed off. A number of instances are recorded in the literature, in which the vessels have been wounded while the deep sutures were being inserted (see chapter on treatment of inguinal hernia—accidents following operation).

Medium sized round full curved needles are ordinarily employed for closing the subcutaneous tissues. For the skin, a sharp pointed cutting edge needle, either straight or curved, is used. The subcuticular suture is the best for the skin closure, and approximation is most accurate if a sharp straight needle is used.

For closing wounds in the intestine and bladder, straight, round milliner's needles are the best. To prevent the thread from slipping, use a needle with a wedge shaped eye. Self threading spring eyed needles are time savers, but are not so durable as ordinary needles. Reverdin's needle, which has a handle attached, is very popular in many countries.

**Abdominal Scars**—In operations for hernia it is seldom possible to place the skin incision so that it follows the natural folds of the skin, thus leaving the minimum amount of scar after healing has taken place. However, in certain hernias, especially in the umbilical and ventral varieties, it is often possible to make the incision in a fold of the skin, where the best cosmetic results are obtained. Other measures that tend to lessen the amount of scar are: The prevention of infection, the use of noncapillary skin sutures such as horsehair, a short incision, a careful hemostasis and the avoidance of drainage in clean cases.

**Hemostasis of Wound**—The importance of having the wound dry before closing it cannot be overemphasized. Hemorrhage from the wound or a slight oozing after the patient reacts from the operation, is responsible for a certain percentage of the infected cases, even when the bleeding is not sufficient to produce an appreciable hematoma.

**Cosmetic Incision**—A cosmetic incision for small inguinal hernia in women is made over the lower part of the inguinal canal and its upper end does not extend above the pubic hairline.

**Painful Scars**—A painful scar is due to the inclusion of sensory nerve fibers in the sutures or in the skin cicatrix. In passing the deep sutures in inguinal hernia operations, it is very important to avoid pressure on the iliohypogastric or ilioinguinal nerves. When the pain is confined to the skin cicatrix, it may be relieved by massage and roentgen ray treatment. If this fails it is necessary to excise the scar. The new wound must be closed carefully with horsehair sutures, in order to avoid the formation of new cicatricial tissue.

**Adherent Scars**—Adherent scars in a hernia wound can usually be freed by massage in conjunction with mild counterirritation, such as hot dressings and roentgen ray treatments. In rare instances, it is necessary to resort to operative measures.

**Cicatricial Keloid**—A cicatricial keloid is a hyperplasia of the scar tissues, which is sometimes tender and painful. The best treatment is massage and roentgen ray. Operation is unsatisfactory as the tumor nearly always recurs.

**Newgrowths in the Incision**—The occurrence of newgrowths, either benign or malignant, in a hernia incision is very rare. They are most often found in the sheath of the rectus muscle and on the aponeuroses of the external and internal oblique muscles. Several cases are recorded in the literature in which the growth has followed an incision in the abdominal wall.

**Ossification of the Cicatrix**—Ossification of the cicatrix is very rare. Beaelli reported a case in which a large calculus developed in the scar of a median abdominal incision. Diagnosis was made by roentgen ray examination before operation.

## DIABETES MELLITUS

Diabetics are poor surgical risks and should never be operated on for non-strangulated hernia without a course of preoperative treatment along with protamine zinc insulin supplemented with unmodified insulin in the proportion of 1:1 to 1:5, depending on the ratio that gives the most satisfactory control of the diabetes. Local anesthesia should be used for strangulated hernia patients with diabetes. Gas oxygen or cyclopropane is next best with spinal only for the good risk patient. These patients do not tolerate well either spinal or ether anesthesia, and the mortality is high, according to Fitz. Diabetics must be maintained sugar free before operation with diet and insulin, and afterwards until wound healing is complete.

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## CHAPTER III

### COMPLICATIONS OR ACCIDENTS OF HERNIA

The complications of hernia are irreducibility, inflammation, obstruction and strangulation. Irreducibility may be the only complication at first, if it is left untreated inflammation often follows favoring the occurrence of obstruction and strangulation. In strangulation all these complications may be present at the same time. For the sake of clarity, they will be considered separately in the order named.

#### IRREDUCIBLE HERNIA

**Irreducibility**—An irreducible hernia is one whose contents cannot be returned into the abdominal cavity. The term is often applied to hernias that are partially reducible. Uncomplicated irreducibility is usually only a temporary condition and under proper treatment such as rest in bed, restricted diet and continued pressure on the tumor, or repeated taxis the hernia will ordinarily become reducible again.

Irreducibility is most common in middle or advanced age; it is rare in children because in them omentum is seldom in the sac. It is more frequent in females because they are more subject to femoral and umbilical hernia than males. It usually occurs in the obese and those who do heavy manual labor. Irreducibility may be due to one of the following causes: adhesions of the omentum to the sac wall; adhesions between the sac contents such as adhesions of the loops of intestine to each other or to the omentum or to other viscera in the sac; an excessive deposit of fat in the omentum mesentery or in the appendices epiploicae in the sac; adhesions between different parts of the sac wall; an accumulation of intestinal contents in the loops within the sac; the narrowing of the neck of the sac which may be due to inflammation in the sac itself or to the irritation and pressure of a truss; and in sliding hernia of the intestine or of the bladder irreducibility is due to a part of the viscus being adherent to the sac wall or in rare instances to the position of the viscus entirely outside of the sac (extrasacellar).

**Sac Contents**—Omentum is the most frequent content of irreducible hernia and is the usual cause of irreducibility. It becomes adherent to the sac wall early and increases in size from fatty infiltration. Large intestine is more commonly irreducible than small intestine. Ovary and tube, bladder, cecum and sigmoid are sometimes found in the sac. Any of the other abdominal viscera may be found but only in rare instances. When a part of the sac is shut off from the abdominal cavity a hydrocele may develop.

**Symptoms and Diagnosis of Irreducible Hernia**—The symptoms of irreducible hernia are similar to those of reducible hernia with the exception that the mass cannot be returned into the abdominal cavity either when the patient assumes the recumbent posture or when taxis is applied. At one of the hernial

openings there is a well defined protrusion, which has a history of a gradual increase in size, and of having been reducible in the beginning. There is a distinct impulse on coughing and when the hernia is small there may be no general symptoms. In large hernias there are frequent attacks of pain, colic, and gastrointestinal disturbances usually associated with constipation.

The pendulous hernia causes a dragging sensation, often referred to the viscera that remain in the abdomen, such as the stomach, transverse colon or small intestine.

**Contusion of Hernia**—Large hernias especially if they are irreducible and in an exposed position, are subject to trauma from blows, falls and crushing injuries, which may result in rupture of the sac with extrusion of its contents. The sac coverings are often very thin and ulceration of the skin from the irritation of clothing or bruising is not uncommon. Sometimes the intestine in the sac ruptures, while the coverings of the sac remain intact.

When acute symptoms follow injury to a hernia operation should be resorted to immediately. A soft tender fluctuating hernia accompanied by increasing rigidity of the abdominal muscles indicates that the intestinal contents are escaping into the abdominal cavity, and that the symptoms of shock and peritonitis will soon follow.

**Prognosis**—The prognosis of irreducible hernia is more serious than that for reducible hernia. On account of the exposed position of an irreducible hernia, the viscera in the sac are subject to frequent trauma from accidental blows or from the rubbing of clothing. As long as the hernia remains irreducible it is liable to become inflamed resulting in obstruction and sometimes in strangulation.

The radical operation is the treatment of choice. Massive hernias of long standing that have lost their *right of domicile* in the abdomen, should not be operated on without preliminary treatment to enable the contents to be returned to the abdominal cavity without causing fatal cardiovascular or pulmonary complications. (For details of preliminary treatment of massive irreducible hernia see chapter on umbilical hernia.)

### *Treatment of Irreducible Hernia*

The treatment of irreducible hernia is palliative or operative.

**Palliative Treatment**—Palliative measures that aid in converting an irreducible hernia into a reducible one are rest in bed with the foot of the bed elevated for several days or weeks, firm continuous pressure by a bandage which is tightened a little each day, gentle taxis daily, or two or three times a week, a diet consisting of nonfattening food, and free catharsis.

As soon as the hernia can be returned, a radical operation should be urged, as there is no prospect of a cure by mechanical means, and the hernia is liable to become irreducible again.

**Operative Treatment**—The operation is the treatment of choice for uncomplicated irreducible hernia. This hernia presents more difficulties than the reducible variety, on account of the intrasacculous adhesions the task of returning the hernial contents to the abdominal cavity and closing the wound.

## INFLAMED HERNIA

An inflamed hernia is one in which peritonitis involves the sac wall or the contents. Inflammation in the hernia may be due to the following causes: irritation from the rubbing of a truss or bandage, trauma such as an accidental blow, attempts at taxis, inflammation extending from a loop of intestine in the hernia or from a diseased appendix, tuberculosis of the hernial sac, and new growths involving the abdominal viscera, the sac or contents.

Inflammation most commonly occurs in femoral hernia and more frequently in the umbilical than in the inguinal variety; consequently it affects more women than men.

**Symptoms**—In acute inflammation of hernia, the symptoms are well defined. The mass is painful, tender on pressure, swollen and edematous. Sometimes there is a localized redness of the skin at one point. There are usually fever and a slight acceleration in the pulse, sometimes gastrointestinal symptoms such as nausea, vomiting and constipation are pronounced. The severity of the symptoms depends largely on what viscera are involved. If omentum alone is in the sac the symptoms are usually mild and of short duration, if the appendix is in the sac and inflamed the symptoms are severe and unless relieved by operation the condition usually terminates in abscess formation or in an extension of the peritonitis to the abdominal cavity. Cases have been recorded in which the skin over the irreducible hernia became irritated and infected and the inflammation spread to all the hernial coverings resulting in a rupture of the sac and extrusion of the viscera. In most instances death followed from peritonitis.

**Prognosis**—The prognosis of inflamed hernia is serious especially so in the aged. The adhesions that follow a mild inflammation may cause the hernia to become permanently irreducible and in this event it is subject to attacks of obstruction and sometimes to strangulation.

**Treatment**—The treatment of inflamed hernia is nearly always palliative. The patient should be kept in bed. The Wangensteen suction tube is used to prevent abdominal distention. For children and adults ice should be applied to the swelling and for the aged hot compresses should be used. It is unwise to use ice for elderly subjects because the skin over the hernia is of low vitality and there is danger of producing gangrene. The bowels should be moved by enemas and no cathartics given until after the bowels move well. In case the inflammation terminates in suppuration or if a hernia of the appendix is suspected an exploratory incision is indicated.

## INCARCERATED OR OBSTRUCTED HERNIA (CHOKED HERNIA)

An incarcerated or obstructed hernia is one that contains intestine whose lumen is occluded from within without any disturbance in the blood supply of the intestinal wall. In incarcerated hernia the passage of both gas and feces

is obstructed usually on account of a fecal impaction or an accumulation of gas in a loop of intestine in the hernia

Obstruction is most common in hernias of the large intestine especially in umbilical hernia of the transverse colon which occurs most often in women, and in inguinal hernia of the cecum or sigmoid usually found in men

**Symptoms**—The symptoms of incarcerated hernia develop slowly and are very indefinite at first. There may be some pain in the hernia and a slight increase in size. On palpation its consistency is firmer than an unobstructed hernia but it lacks the nixed tenseness that is found in strangulation. If the fecal impaction is large the hernia may feel like dough or putty, and is dull on percussion. There is a slight impulse on coughing.

There is usually vomiting but it is not so severe as in strangulation, and it is stercoraceous only rarely. There are often colicky pains and abdominal tympanites. Constipation is marked but it is seldom complete.

**Prognosis**—The prognosis of incarcerated hernia depends on the duration of the symptoms and the age of the patient. In children and adults when the symptoms are of recent onset the outlook is usually favorable. In the aged the prognosis is always grave because the symptoms are indefinite and of gradual development they are liable to be confused with the ordinary complaints associated with old age and strangulation may occur before the cause of the symptoms is recognized.

#### DIFFERENTIAL DIAGNOSIS OF OBSTRUCTED, INFLAMED AND STRANGULATED HERNIA

	OBSTRUCTED HERNIA	INFLAMED HERNIA	STRANGULATED HERNIA
Onset	Gradual	Gradual	Sudden
Impulse on coughing	Present	Present	None
Pain	Not marked	Not marked	Severe over hernia and abdomen
Tumor	Little tenderness or tension	Tender no let on	Marked tenderness very tense
Vomiting	Usually absent	Slight	Severe continuous
Constipation	Absent	Absent	Absolute
Prostration and shock	None	None	Severe in infants and the aged
Pulse	No change	No change	Rapid later weak and thready
Temperature	Normal	Slight elevation	Elevated at first later subnormal

**Treatment**—If the possibility of strangulation can be definitely excluded palliative treatment is indicated. The patient should be kept in bed with the foot of the bed elevated and no food given by mouth. For adults ice should be applied to the swelling, and for children and the aged hot compresses should be used. Except in cases seen a few hours after onset taxis is dangerous and never to be recommended.

High enemas should be given frequently and after the bowels move it is safe to give a laxative. If the obstruction is not relieved in a few hours operation should be resorted to just as for strangulated hernia. If the diagnosis is not positive when the patient is first seen and there is a possibility of strangulation operation should be undertaken immediately.

## STRANGULATION

**Definition**—A strangulated hernia is one which contains abdominal viscera whose blood supply is partially or completely obstructed

### Historical

The clinical characteristics of hernial strangulation were known to Hippocrates, who lived in the fourth century B C. Taxis was practiced for its relief by Praxagoras of Cos in the third century B C, he believed that strangulation was due to an accumulation of hardened feces in the protruded intestine. This theory was accepted by Celsus and Aretæus in the first century A D, by Paulus Ægineta in the seventh century, by Avicenna in the eleventh century, and was not generally abandoned until the beginning of the nineteenth century.

Pierre Franco, in 1556, devised an operation for strangulated hernia. He suggested that sometimes the condition was due to an accumulation of gas in the hernial loop. He opened the sac only as a last resort, when the hernia could not be reduced after the division of the overlying tissues. In 1672 Lavater suggested that it was often due to pressure on the neck of the sac and was sometimes the result of inflammation.

Riolan, in 1658, described the hernial rings and ascribed an important rôle to them in the production of strangulation. The operation was also described by Pare in 1579, and by LeQuin in 1697. Dionis in 1698, and Mauchart in 1722 stated that strangulation was due to a spasmodic contraction of the external and internal oblique muscles associated with a disproportion between the protruded intestine and the constricting ring.

### Pathology of Strangulation

The pathologic changes in strangulation begin with an occlusion of the lumen of the intestine, at first partial and then complete as peristalsis finally ceases. The condition is often aggravated and hastened by the ill advised use of cathartics. As the intestine above the point of strangulation dilates, it is aided by the multiplication of bacteria always present in the intestinal tract. As a result, circulation is obstructed or ceases in the strangulated loop. Then follow edema and swelling of the intestinal wall and perforation and peritonitis. Bhajekar, in 1947 published an excellent paper on strangulation.

### Anatomy

The anatomical structures affected by strangulation are the coverings of the hernia, the hernial sac, and its contents. Sometimes pathologic complications in the abdominal cavity also occur, such as retrograde strangulation, perforation, hemorrhage, and volvulus of the omentum, intestine or mesentery.

### Causes of Strangulation

Strangulation is due to a constriction that presses on the sac contents and obstructs their blood supply. This constriction is nearly always exerted by one of the hernial rings. Strangulation by the neck of the sac alone is infrequent,

and intrasacccular strangulation, due to adhesions or constriction in the sac wall, or to a torsion of the hernial contents, is still more uncommon

**1 Strangulation by the Hernial Ring**—Strangulation by the hernial ring, or extrasacccular constriction, is found in a large majority of strangulated hernias. The constricting point consists of fibrous tissue or fascia, such as Gimbernat's ligament in femoral hernia, and the external inguinal ring in inguinal hernia. The hernial ring is usually small, rigid and unyielding and sometimes it presents a sharp edge as in the case of the lacunar ligament. In small inguinal hernia, strangulation is often due to a small resistant external ring. After the ring enlarges and its pillars become weakened and thinned out, strangulation is comparatively rare.

**2 Strangulation by the Neck of the Sac**—Constriction by the neck of the sac is infrequent and modern writers attach little importance to it. The neck of the sac is narrow and cannot be dilated as it is held by the walls of the hernial canal. The older surgeons believed that strangulation was caused by the neck of the sac, which was found to be thickened, and often narrowed by fibrous or inflammatory adhesions that were due, as a rule, to the pressure of a truss or to other trauma, this is true especially in inguinal hernia, when the neck of the sac is compressed between the truss pad and the pubis. In adults with congenital inguinal hernia, there are often sharp constricting bands at the mouth of the sac. Blakeway stated that strangulation by the neck of the sac in adults is more frequent than is generally supposed.

**3 Strangulation by the Hernial Ring and the Neck of the Sac**—In rare instances, strangulation is due to the pressure exerted by both the hernial ring and the neck of the sac. The hernial ring is the primary cause of strangulation, but even after it is divided, the hernia cannot be reduced until the thick, resistant neck of the sac is opened up to the internal ring. When these two structures jointly produce strangulation, it is usually in subjects with inguinal or femoral hernia of long standing, who have persevered with truss treatment.

**4 Strangulation From Other Causes**—Unusual causes of strangulation are as follows: (1) a diverticulum in the sac, especially in umbilical hernia, (2) constriction from bands of the cribriform fascia in femoral hernia, (3) constriction from intrasacccular adhesions in voluminous hernias, (4) constriction by the omentum, which presses on a loop of intestine, or else becomes inflamed and adheres to the sac wall in such manner as to narrow the lumen of the neck of the sac, (5) constriction from an adherent appendix, from a Meckel's diverticulum, or an epiploic appendix in the hernial sac, (6) strangulation due to volvulus or torsion of the sac contents, (7) constriction by an opening in the mesentery or omentum through which a loop of intestine passes, (8) retrograde strangulation.

**5 Strangulation From External Causes**—In rare instances strangulation may be due to conditions outside of the hernial canal and sac, such as constriction produced indirectly by tumors, inflammation, etc.

**Retrograde Strangulation (Hernia in "W", Double Loop Hernia, Maydl's Hernia)**—In retrograde strangulation the sac contains two loops of intestine

The portion of intestine between the two loops remains in the abdominal cavity (Fig 3). This form of hernia was termed *hernia in W*, by Maydl. Laroyenne observed a case in which the third or connecting loop was six feet (2 meters) long. Retrograde strangulation of the appendix or Meckel's diverticulum is very infrequent. When it occurs the gangrene is usually limited to the distal portion which lies in the abdominal cavity (Fig 4). Ottobiani, Costa and Guerrero Cocuzzi collected 50 cases in the literature of strangulated hernia in 'W'.



Fig 3



Fig 4

Fig 3—Retrograde strangulation. The portion of intestine between the two loops remains in the abdominal cavity.

Fig 4—Retrograde strangulation of the distal portion of the appendix.

### Pathologic Changes of the Hernial Sac

In strangulation the hernial sac presents a tense globular mass with its peritoneal surface edematous and congested. In neglected cases when the gangrene of the bowel is extensive the sac may also be involved. Cases have been observed in which the sac was gangrenous and the intestine viable.

Very rarely the sac may rupture spontaneously or as a result of taxis. A neglected abscess of the hernial sac will perforate the sac wall and its coverings drain externally and finally terminate in a fecal fistula.

**Fluid in the Sac**—If the obstruction in the blood supply is incomplete only the venous circulation is impeded with the result that there is an effusion of serum into the sac. This serum is at first limpid, clear and lemon colored, but as the venous stasis increases there is a migration of red blood cells through the walls of the mesentery and intestine, that changes the color to a light red.

or brown, and if taxis has been employed, considerable blood may extravasate into the sac, turning the serous exudate dark brown in color. The fluid is at first sterile and contains flakes of fibrin but later, when colon bacilli and other bacteria pass through the intestinal wall it becomes turbid has a foul fecal odor, and sometimes contains gas. On account of the lowered vitality of the hernial contents the virulence and proliferation of bacteria in the strangulated loop are rapidly increased.

**Pathologic Changes in the Intestine**—The changes in the intestine are of the greatest importance because the treatment and prognosis depend upon them. The amount of intestine strangulated is usually small. In fact, small hernias are more subject to strangulation because their hernial ring is narrow. The length of the strangulated loop in femoral hernias rarely exceeds six to twelve inches (15 to 30 cm.) and in inguinal hernias twelve to twenty-four inches (30 to 60 cm.). When only a portion of the intestinal caliber is strangulated the hernia is known as a partial enterocoele or a *nipped* hernia, or Richter's hernia.

The following pathologic changes occur in strangulated intestine: (1) congestion, (2) inflammation, (3) ulceration and gangrene.

**1 Congestion**—In the beginning of strangulation the intestine is bright red in color, and the turgescient veins are distinctly seen under the serosa of the intestine and in the mesentery. As the congestion increases the intestine grows darker in color either bluish black or purple. It becomes distended, as a result of increasing intraintestinal pressure and may attain twice its normal size. The serosa usually remains shiny throughout the stage of congestion, although the intestine and mesentery show signs of beginning edema. The intestine will bleed if it is pricked.

**2 Inflammation**—As the venous stasis increases and the constriction gradually cuts off the arterial supply the congestion is replaced by ecchymotic spots on the intestine which gradually spread to all the constricted loop. The edema increases the smooth glossy serosa becomes rough and dull and there is a fibrinous exudate which sticks to the fingers. The lowered vitality of the intestine favors the migration of bacteria through the intestinal wall and infection of the sac cavity is followed by inflammatory processes involving the sac wall and other contents.

The intestinal mucosa is swollen, injected and often presents membranous patches of serous exudate which cover ulcers of the mucosa. The effects of inflammation are most pronounced at the point where the neck of the sac is constricted, often a distinct furrow can be seen here, and the ecchymosis is more marked than farther down on the convexity of the loop. The intestine has lost its tone, it feels thin and is very friable. If the constriction is relieved at this stage the viability of the intestine is so low that ulceration and perforation often occur in spite of the restoration of circulation and color in the strangulated loop. When intestine of such questionable vitality is returned to the abdominal cavity abdominal peritonitis develops within a few hours or days.



**3 Ulceration and Gangrene**—Ulceration and gangrene are closely associated. Ulceration nearly always develops first, at the point where the intestine is directly under pressure by the constriction. On account of the vascularity of the mucous membrane it is the first to suffer from the effects of strangulation and ulceration may involve a portion of it or its entire thickness. The circular muscular fibers are the next to yield and then the longitudinal fibers give way. The resistant connective tissue fibers outlive the muscular layers but become ulcerated before the serosa is cut through. The furrow caused by the constriction is deepest and the ulceration most marked at a point opposite the sharpest and most unyielding part of the constricting ring. In femoral hernia the ulceration nearly always appears first at the point where the neck is constricted by the thin edge of the lacunar (Cimbernat's) ligament as though the intestine were broken on its own edge.

The effects of strangulation are not the same for all parts of the strangulated loop but are most marked at the point of constriction and at the upper part of the proximal end of the loop. The latter point is drawn against the ring by the distended intraabdominal intestine and also by the tense loop in the hernia.

Gangrene may occur as early as five or six hours after the onset of the first symptoms of strangulation. It appears earliest in strangulated femoral hernia. The intestine loses its luster and has a deep purplish ashen gray or dead leaf color. The color of strangulated intestine is due to the coloring matter of the blood which as it decomposes changes to various shades of brown or green. If the tissues were not discolored by blood all gangrenous intestine would be white.

The necrotic area may be only a small point on the bowel wall or it may involve a portion of the circumference and in severe cases the entire loop is gangrenous. In the early stage of gangrene before perforation the intestine retains some of its firmness and distention as the necrosis extends the intestine collapses often lying in folds and the walls feel soft and are very friable. J. D. Sala writing in the sixteenth century remarked that gangrenous intestine tears like wet paper. The gangrenous loop has a much lower temperature than living tissue. Sometimes the peritoneal coat remains intact while the underlying muscular and mucous coats are destroyed. The serous muscular and mucous layers are separated from each other by collections of dark brown or blackish serum or by circumscribed hemorrhagic areas.

In the beginning nonperforated gangrenous intestine has a cadaverous odor which gradually becomes foul or fecal as the bacteria in the lumen penetrate the intestinal wall. When perforation takes place the contents of the loop invade the hernial sac and the inflammation that follows extends to the coverings of the hernia and if the patient lives long enough the enlarging abscess breaks through and forms a fecal fistula. Occasionally the infection breaks down the protective adhesions at the abdominal ring enters the peritoneal cavity and terminates as a rule in a fatal peritonitis.

If left untreated the gangrenous loop separates from the viable intestine and usually comes out in shreds through the fecal fistula opening. In rare

instances it comes out in one piece. In the Museum of Guy's Hospital, London there is a specimen of intestine five and one half inches (13.75 cm) long that was extruded through the hernial wound a week after incision for drainage.

**4 Hemorrhage**—Hemorrhage either peritoneal or into the lumen of the strangulated intestine is not uncommon when diagnosis or operation is delayed. Larghero Ibarz has discussed the subject at length.

**5 Site of Perforation**—Perforation most frequently occurs at the convexity of the strangulated loop. In 23 cases observed by Reichel perforation occurred at the point of constriction 4 times, 9 times at the convexity of the loop 7 times at both the convexity and the point of constriction and the whole loop was gangrenous 5 times. (Figs 5 and 6)

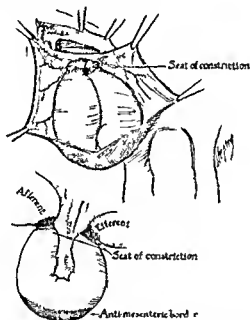


Fig 5—Gangrene and perforation of the intestine. When the strangulated loop is pulled down a groove or furrow can often be seen at the point of constriction.

Fig 6—Gangrene and perforation occur most frequently at the convexity of the loop on the antimesenteric border and less often at the point of constriction.

**6 Contents of the Strangulated Loop**—When the strangulated loop consists of small intestine the usual contents in the beginning are a small amount of gas and a lemon colored serous fluid which is secreted by the mucous membrane and its glands. As the strangulation continues the contents become thickened often to the consistency of mucus and are reddish brown in color from hemorrhagic oozing from the intestine. Fecal matter is very seldom found in strangulation of the small bowel but is often a part of the intestinal contents when a loop of large intestine is strangulated especially if it is descending colon or sigmoid. When bacteria invade the contents of the strangulated loop the fluid becomes septic and has a foul fecal odor.

**7 Strangulated Mesentery**—The changes in the mesentery are similar to those that take place in the intestine. The mesentery is swollen and congested with numerous patches of ecchymosis. Often there are circumscribed hemorrhages between its layers and the mesenteric vessels are usually thrombosed.

### Separation of the Mesentery

Separation or laceration of the mesentery is a rare complication of hernia only a few cases being recorded in the literature. The separation occurs between the intestinal border of the mesentery and the intestine and according to Rabere and Charbonnel it is nearly always due to traction on the mesentery.

The last part of the ileum is the portion of the intestine usually involved. In a study of the cases reported in the literature separation most frequently occurs on the right side, and inguinal and femoral hernia are about equally affected.

**Etiology**—The etiology of separation of the mesentery is undetermined. The following are predisposing factors: friability of the inelastic mesentery; gangrene of the mesentery; overdistention of the intestinal loop in the sac and a sac of voluminous proportions that fails to hold the intestinal loop in contact with the rigid mesentery. The active cause is probably always mechanical traction which pulls the intestine loose from the mesentery.

**Prognosis**—The prognosis of separation or laceration of the mesentery is very grave. I have collected 13 cases in the literature and of these 4 patients died following operation.

**Treatment**—The treatment consists of making a V shaped excision of the gangrenous mesentery, carefully ligating the mesenteric vessels to prevent secondary hemorrhage, resecting the intestinal loop which has been deprived of its blood vessels and anastomosing the ends of the healthy intestine.

**Lesions of the Intestine in the Abdomen**—*1 Above the Constriction*—The intestine that lies in the abdomen above the constriction (afferent loop) is edematous and dark colored from venous congestion and the bowel above the obstruction is distended by gas and semiliquid contents. The peristaltic waves from the intestine above increase the tension. Sometimes the intestine just above the constriction is two or three times its normal size and this distention may cause a paralysis of the muscular layers. In addition to the congestion of the peritoneal covering the mucous membrane is edematous and ecchymosed and may also be eroded in places.

*2 Below the Constriction*—The intestine that lies below the constriction (efferent loop) is of normal size and color and is empty. The portion lying in proximity to the constriction is more or less congested and suffers from disturbances in circulation with the result that there is often an acute enteritis of the mucous membrane.

**Frequency of Strangulation**—Strangulation occurs more often in irreducible hernia than in the reducible form. Of the four principal varieties femoral hernia strangulates most often and iliac is next in frequency. inguinal hernia does not strangulate often and ventral hernia strangulates only rarely.

**Elastic Strangulation**—The theory of elastic strangulation probably explains the mechanism of strangulated hernia in a majority of cases better than any other theory. The sac may be empty previous to the onset of the attack or if intestine or omentum is in the sac the amount is ordinarily small and there are no signs of obstruction because the fibrous hernial ring is somewhat elastic.

As a result of sudden increase in intraabdominal tension additional intestine or omentum distends the ring and enters the sac. When the pressure is removed from the hernial ring, it returns to its normal size and presses on the intestine or omentum that failed to return to the abdominal cavity when the increased intraabdominal pressure ceased. Peristalsis from above the constriction forces additional fluid and gas into the obstructed loop and as the distention increases obstruction in the blood supply develops in the mesentery and in the intestine inside the sac and is aggravated by edema and swelling. This is the stage of congestion.

Bolognesi concluded from an experimental study that it is difficult to produce strangulation by means of a rigid constricting ring but it is an easy matter to induce it with an elastic ring. Ritter carried out a series of experiments on elastic strangulation and concluded that the first stage of anemia and contraction of the loop is soon followed by relaxation, distention, inflammatory hyperemia and swelling.

**Changes in Circulation Due to Pressure**—Van Zwalenburg studied under the microscope the circulation in the wall of the living intestine. The intestine was opened, an electric light bulb inserted and a cannula tied in the incision. By forcing water through the cannula to distend the intestine some of the capillary streams were checked when the pressure reached 30 mm. of mercury. Many vein currents were stopped and the individual corpuscles could be seen when the pressure reached 60 mm. all circulation stopped at 130 mm. Fechyosis developed early at 50 mm. The intestine kept at a pressure of 80 to 90 mm. for an hour became intensely congested.

**Frequency of Strangulation**—Strangulation is the most frequent complication of hernia. In 10,000 cases of hernia studied by Berger there was temporary irreducibility in 43, hernial peritonitis or inflammation in 58 and strangulation in 250.

#### Predisposing Causes

**Sex**—Strangulation is most often encountered in males because a large majority of hernias occur in them. However the percentage of strangulation is much higher in females (14.06 per cent. Berger) in proportion to the number afflicted. In males the percentage is 3.61 according to Berger. In females pregnancy and obesity are important predisposing causes. In 225 cases of strangulated hernia in infants under two years of age collected by Estor 205 were in females and in 15 the sex was not given.

**Age**—Strangulation is most frequent in middle life and old age. It is rare in infants, infrequent in children and seldom seen before the twentieth year when it gradually begins to increase in frequency, reaching the maximum in males between the fortieth and fiftieth years and in females between the sixtieth and seventieth years.

In 120 of the cases collected from the literature by Estor strangulation occurred during the first six months (40 in the first month) in 49 it occurred in the second half of the year and in 54 it occurred during the second year. In infants the danger of strangulation is greatest during the first month of

life and steadily decreases thereafter. Ector estimated that the frequency of strangulation in infants and adults was 1 to 62 while Eickhoffer placed it at 1 to 107.

**Site of the Hernia**—The frequency of strangulation depends largely on the location of the hernia certain varieties being very much more liable to it than others. Femoral hernias strangulate most frequently 64.5 per cent in men and 90.0 in women (Berger). This fact is due to the small fibrous ring and the sharp cutting edge of the lacunar (Guibernet's) ligament. Umbilical hernia strangulates next in frequency and finally inguinal.

According to Berger, the frequency is as follows:

	MEN	WOMEN	TOGETHER
Inguinal hernias in 100	1.34	2.16	1.43
Femoral hernias in 100	9.03	9.07	9.45
Umbilical hernias in 100	0.24	0.89	1.19

In Ector's series 20 were inguinal 14 umbilical and 2 femoral.

**Congenital Causes**—Congenital or preformed sites are the principal predisposing factors of inguinal and femoral hernia and are also the cause in a lesser degree of other hernias. Other congenital causes are deficient muscular development relaxed inguinal rings malformation etc.

**Size of the Hernial Ring**—Well developed hernias that have been controlled by a truss are more liable to strangulate than those that have been neglected and have developed large hernial rings. When a truss is worn the irritation of the pad produces an inflammation in the neck of the sac causing it to become thickened and to contract. Often the neck is narrowed still more by pieces of omentum becoming adherent to it.

**Time of Onset of Strangulation**—Many hernias strangulate the first time they come down especially femoral hernias. Of 239 cases of strangulated hernia studied by Berger 48 strangulated the first time they came down 89 strangulated within ten years of their onset, and 102 strangulated more than ten years after their onset.

**Exciting Causes**—The active or exciting causes of strangulated hernia are the same as those that apply to the nonstrangulated varieties namely any factor that causes an increase in intraabdominal tension such as a strain a fall trauma whooping cough bronchitis etc.

### Symptoms and Diagnosis

The symptoms of strangulated hernia are usually well defined and diagnosis is easy. However in the event that one or more of the characteristic symptoms or signs is absent there may be considerable difficulty. The onset of strangulation is usually acute ordinarily following an increase in intraabdominal tension caused by lifting a full man's step etc.

As a rule strangulation occurs in patients whose hernias are down or have been controlled by a truss. Sometimes the patient leaves off his truss from neglect or from a belief that he is cured. However strangulation is most often

caused by the hernia slipping by the truss. Whether the hernia is already down or comes down suddenly, the patient notices a rapid increase in size and tension as additional viscera are drawn into the sac, and congestion develops followed by inflammation.

**Functional Symptoms**—The most important functional symptoms are pain, nausea and vomiting, constipation, prostration and shock.

**Pain**—There is almost always pain in the early stages of strangulation. It usually comes on suddenly, and is first noticed over the hernial ring. It is a sharp griping pain of an excruciating character, and is due to peristaltic waves from above the obstruction attempting to overcome the constriction. There is nearly always a colicky pain over the abdomen and often in the region of the umbilicus that comes on in paroxysms. As the strangulation increases the pain becomes more severe and is continuous, perhaps causing the patient to double up.

The pain does not stop until the peristaltic contractions cease. Intestinal peristalsis is checked by the development of gangrene, the division of the constriction or the administration of an opiate. The spontaneous cessation of pain is a grave symptom. It gives the patient a false sense of security. The operator may be led to delay operation and the condition soon terminates in death.

**Nausea and Vomiting**—There may be nausea without vomiting when only a portion of the lumen of the intestine is obstructed as in partial enterocele, hernia of the appendix, etc. Vomiting is perhaps the most important sign of complete obstruction or strangulation and it becomes on soon after the constriction of the intestine is complete. It occurs earlier when the obstruction is in the upper part of the intestinal tract than when it is in the lower part of the ileum or in the large intestine.

In the beginning vomiting is projectile and purely reflex and consists of the ejection of the contents of the stomach, duodenum and the upper part of the jejunum. If the strangulation is not relieved the vomiting gradually becomes more severe, the vomitus consisting of bile and intestinal contents with a fecal odor. At this stage the vomiting is due to reversed peristalsis or to stimulation of the vomiting center by the toxic products of the strangulated loop. The vomiting is usually continuous although it sometimes has periods of omission and it persists until the constriction is divided or until death. In very rare instances there is no nausea or vomiting even after the gangrenous intestine has ruptured into the sac.

Vaughan studied 25 cases of strangulated hernia and found that pain was present in all, vomiting occurred in 20, nausea without vomiting in 2 and in 3 there was no nausea or vomiting.

**Constipation**—Constipation is complete when the entire lumen of the intestine is constricted. When the upper part of the small intestine is strangulated a considerable amount of feces may be brought away by enemas and in the beginning of strangulation this fact is liable to cause the inexperienced to make a diagnosis of partial obstruction. After the bowel below the obstruction

is emptied neither gas nor feces are passed by the rectum. When the strangulation involves the descending colon or sigmoid there is sometimes an urgent desire to go to stool.

An enteritis of the bowel below the obstruction in the beginning of strangulation, may cause *diarrhea*, which stops after vomiting sets in. When only a portion of the lumen is obstructed, constipation is not complete, some gas and feces are passed by rectum, and in isolated cases there may be diarrhea.

*Prostration and Shock*—Prostration and shock are serious symptoms, and when they appear the outlook is grave. Prostration occurs early in infants in young children, in the aged, and in those enfeebled from disease or from repeated attempts at taxis. The onset of prostration and shock is apparent in the appearance of the patient. The face is pinched and has an anxious expression, sometimes called the *facies abdominis* by the older writers. The eyes are sunken, dull and lusterless, the skin is cold, clammy and moist and the breathing is labored, rapid and shallow. The skin is cyanotic, the lips are blue, and the tongue dry and heavily coated. The pulse, at first rapid gradually becomes slow, weak and easily compressible and the temperature often elevated in the beginning, gradually falls to subnormal. There is often tympanites when the obstruction is low down in the intestine, the distention is pronounced and it is still more marked if there is a complicating abdominal peritonitis. The urine is scanty or suppressed in advanced strangulation. Hiccough usually appears later and may be associated with other terminal symptoms such as muscular cramps, tremors, coma and delirium.

The graphic description of the symptoms of strangulation written by Aretæus, in the second century A.D., remains a classic today, and has never been excelled by any author.

**Acute Coronary Thrombosis**—Acute coronary thrombosis is sometimes mistaken for a small occult strangulated hernia that lies hidden by muscle or fatty tissues.

**Objective Signs**—In strangulation the hernial mass is painful tense and irreducible, and yields no impulse on coughing. It is sometimes fluctuating and is usually dull on percussion. No sound is heard on auscultation.

In rare instances there are no objective signs in very small hernias in obese subjects in interparietal hernias, and in hernias that have reduced *en masse*.

*1 The Hernial Swelling*—There is an irreducible mass at one of the hernial openings that has usually been reducible previous to the onset of the strangulation. There is pain over the tumor, especially in the region of the constricting ring which is continuous sometimes of a burning or cutting character, and is aggravated by manipulation or attempts at taxis. There is also tenderness on pressure. In the beginning of strangulation the irreducible swelling increases in size, owing to additional viscera being drawn into the sac, and to an accumulation of fluid in it. The tension gradually increases and the viscera cannot be palpated. If arterial and venous strangulation occur suddenly and at the same time, the tenseness is often not marked.

**2 Palpation**—On palpation the tumor is hard and resistant. When the patient coughs, no impulse is detected in the mass, and when an infant cries, the expansile impulse is also lacking. There is often fluctuation in a strangulated hernia that has been of slow onset, and in which the sac contains fluid. Fluctuation is absent when the sac is very tense or when there is only a little fluid in it.

**3 Percussion**—Strangulated hernia is usually dull on percussion, owing to the presence of fluid in the sac or within the strangulated loop.

**4 Auscultation**—In strangulated hernia no gurgling sounds over the tumor are audible.

**5 Strangulated Hernia Without External Swelling**—Strangulated hernias that present no local signs of a tumor were called *masked hernias* by the older writers, and included obturator, sciatic, and small inguinal, femoral, and ventral hernias in which only a portion of the intestinal caliber was involved (partial enterocele).

**6 Signs of Gangrene**—In neglected cases of strangulated hernia, the general symptoms are those described under prostration and shock, while the local signs are edema and congestion over the hernia, often with a black area in the center, subcutaneous emphysema, cessation of pain, softness and shrinking of the tumor, and occasionally spontaneous reduction. Should the patient survive this period, the skin over the hernia nearly always ruptures and a fecal fistula forms.

**7 Strangulation as a Complication of Other Diseases**—Strangulation may develop as a complication of a more serious condition, and when the severity of the symptoms is out of proportion to the size of the hernia some other intra-abdominal condition, such as a volvulus or a perforative peritonitis, should be suspected. Failure to recognize and relieve the primary condition results in a continuance of the symptoms and usually in the death of the patient.

### Differential Diagnosis

**Partial Enterocele**—The symptoms of partial enterocele are similar to those of complete enterocele with the exception that vomiting is less severe, constipation is not absolute, and the other symptoms are also milder. The tumor is small, and for this reason partial enterocele must not be confused with hernia of the appendix and hernia of Meckel's diverticulum. Because the symptoms are indefinite, diagnosis is difficult and often delayed, consequently the mortality is higher than in ordinary hernia.

**Strangulated Omental Hernia**—The changes that occur in strangulated omental hernia have been described with those of hernia of the intestine with which it is usually associated. When omentum is alone in the sac, the symptoms are similar to those of strangulated intestine, but are much milder, and there is seldom colicky abdominal pain. Nausea and vomiting are not marked and may be absent. Constipation is not absolute. The local swelling is usually small, somewhat tender, irreducible and dull on percussion, sometimes the irregular lobules of omentum can be felt through the hernial openings.



**Other Conditions**—Inflamed lymphatic glands must not be mistaken for strangulated hernia. The points in differential diagnosis are taken up in the chapters on inguinal and femoral hernia. It should be remembered that an abscess of a lymphatic gland sometimes overlies a strangulated hernia and conceals it.

Orethritis and epididymitis cause no confusion if a careful examination is always made of the inguinal canal and rings.

An undescended testis seldom causes confusion. There is no testis in the scrotum on the side of the suspected hernia. In rare instances, when the testis is in the inguinal canal near the internal ring it may be impossible to exclude partial strangulation before operation.

Inflammation of the hernial sac or cord structures is rarely mistaken for strangulated hernia. In this case there would be no symptoms of intestinal obstruction such as vomiting, abdominal distention, etc.

Hydrocele of the cord in infants and young children is sometimes mistaken for strangulated hernia. In hydrocele of the cord the symptoms of strangulated hernia are wanting. The tumor is fluctuating, dull on percussion and translucent, however translucency is of little value as enterocoeles in infants and young children are often translucent.

The vomiting of pregnancy associated with irreducible hernia is not misleading if there is positive evidence of pregnancy and the other signs of obstruction are absent.

### Prognosis

The prognosis of strangulated hernia is always serious. It is most favorable with infants and children, its gravity increasing as age advances. When omentum and intestine are in the sac together the effects of the constriction are less severe and less extensive than when intestine alone is strangulated. In partial enterocoeles the strangulated area is smaller than in complete enterocoeles but the prognosis is more serious on account of the onset of gangrene which occurs earlier than in complete enterocoeles and the delay in operative intervention due to difficulties in diagnosis.

In suspected strangulation operation is the only treatment to be advised and it cannot be undertaken too early as the mortality rate is directly proportional to the promptness with which the strangulation is relieved. The death rate of irreducible strangulated hernia unrelieved by operation is nearly 100 per cent.

The prognosis of strangulated massive hernias that have been outside of the abdomen a long time and have lost their right of domicile is very grave. The increase in intraabdominal tension that follows the return of these viscera to the abdomen is often the cause of fatal pulmonary or cardiovascular complications (see chapter on umbilical hernia).

The mortality rate for strangulated hernia has decreased very little in the last twenty-five years. This is largely due to the fact that the surgeon selects an operation that is beyond the recuperative powers of the patient; the after-treatment is not given sufficient attention and general anesthesia is too often

employed when the local method should be used. I believe that no substantial reduction will be shown in the mortality rates until local anesthesia is generally adopted as the anesthetic of choice for strangulated hernia operations.

### Treatment

Immediate operation is the treatment of choice for strangulated hernia. As Stromeyer remarked nearly a century ago if a case of strangulated hernia is seen in the daytime, the patient should be operated on before the sun sets and if it is seen in the night he should be operated on before the sun rises.

**Taxis**—Taxis was used by the ancients and the technique was described in detail by William of Salicet in the thirteenth century. It is sometimes permissible to attempt taxis for strangulated hernia when the patient is seen within two or three hours after the onset of symptoms. It is more likely to be successful in infants and children than in adults and for large hernias more than for small ones and in inguinal and femoral hernias more than in umbilical hernias. Taxis should never be continued for more than five minutes and only a moderate amount of force should be used even with the patient under anesthesia. Inversion of the patient is sometimes helpful. The methods of taxis for the different varieties of hernia are described in their respective chapters.

**Posture for Taxis**—There are certain postures that are in aid to taxis. Infants and children can be suspended by their feet or slung up over the shoulders of an assistant while taxis is employed. A hot bath before this maneuver is often helpful; this was employed by the ancients who also suspended the patient by the feet to facilitate reduction.

For adults the following positions sometimes favor the success of taxis: the knee elbow, knee-chest, Sims, and Trendelenburg positions with the knee bent. (Other positions for taxis are discussed under treatment in the chapters on the different varieties of hernia.)

**Contraindications to Taxis**—Taxis is contraindicated under the following conditions: (1) when the hernia has been down several hours; (2) when the onset is acute and the symptoms are severe; (3) when previous attempts at taxis have failed; (4) when the coverings of the hernia are inflamed or edematous; (5) when there are symptoms of prostration and shock; and (6) when there are signs of ulceration and gangrene.

**Dangers of Taxis**—The principal dangers of taxis are: (1) reduction of the hernia *en masse* with a persistence of the symptoms of strangulation; (2) rupture of the intestine; (3) contusion or laceration of the intestinal wall; (4) the reduction of gangrenous intestine into the abdominal cavity; (5) the forcing of infected sac contents into the peritoneal cavity; (6) the danger of ulceration and perforation of reduced intestine developing several hours or days after reduction; (7) the occurrence of intestinal hemorrhage resulting from too forcible taxis; (8) incomplete reduction—the reduction of only part of the strangulated intestine into the abdominal cavity; (9) rupture of the sac near the neck and the subperitoneal reduction of the hernia; (10) the danger of tearing loose the constriction at the neck of the sac and reducing it along with the intestine into the abdominal cavity; (11) the danger of failing to re-

have the strangulation when the constriction is intrasaccular, (12) torsion of the loop persisting after reduction and (13) intestinal paresis that often follows forcible or repeated taxis chiropactors strike a sharp blow on the hernia

The possibility of strangulation being due to adhesion in the sac should be carefully considered before attempting taxis There may be a very extensive adhesion that does not cause harm while a very narrow band may produce obstruction Even if the hernia can be successfully reduced unless the constriction is relieved the symptoms will persist and gangrene will develop often with a complicating abdominal peritonitis

### Reduction en Masse

#### (Reduction en Bloc, Displaced Hernia)

Reduction *en masse* is the reduction of a strangulated hernia without relieving the constriction of the intestine It was described by SAVIARD in 1702 by Le Dran in 1731 and more thoroughly by Richter in 1785

**Varieties**—There are three varieties of reduction *en masse* (1) Properitoneal reduction the strangulated intestine is reduced into an empty loening of a bilocular sac (2) Interstitial reduction without rupture of the sac the sac containing the strangulated viscera is dislocated upward between the layers of the abdominal wall (3) Interstitial reduction with rupture of the sac the sac ruptures and the intestine is displaced to a position between the layers of the abdominal wall the strangulation at the neck of the sac remaining unrelieved

**Etiology**—As a result of manipulation or taxis the sac is freed from the subcutaneous tissues the constricting ring dilated and the hernia displaced to a position beneath the peritoneum inside of the internal abdominal ring The point of strangulation is in the neck of the sac Sometimes the reduction *en masse* is the result of the patient's attempts to reduce the hernia When a patient tries to reduce his own hernia or calls on his friends to help him they use more force and apply it more carelessly than does the physician (Figs 7 8 and 9)

When inguinal hernia in the aged is associated with an excessive amount of extraperitoneal fat and relaxation of the peritoneum reduction *en masse* may follow the gentlest degree of taxis

**Age Sex and Site**—Reduction *en masse* occurs most frequently between the thirtieth and sixtieth years nearly always in males and it is most common in the inguinal region

Corner and Howitt collected in the literature 137 cases of reduction *en masse* In 68 subjects the hernia was on the right side in 39 on the left, and in the remaining 30 the side was not stated

**Frequency**—A majority of the cases of reduction *en masse* reported in the literature were found at autopsy or were reported in the days when taxis was always attempted before resorting to operation In the last ten years only a few cases have been recorded a fact which is due no doubt to the general abandonment of violent taxis and to the earlier recourse to operation

In 12,000 cases of hernia operations collected from hospital records by Eliason, there were no cases of reduction *en masse*. On the other hand, Nason and Mixer found 3 cases of reduction *en masse* in 632 hernias of all types. Undue force or taxis was not a prominent feature in the history of these 3 cases.

**Autoreduction en Masse.**—Autoreduction *en masse* is very rare. Wolfe reported strangulation two months after self-induced reduction of an old scrotal hernia. He was able to find only 3 similar cases in the literature. The diagnosis is difficult, but with a history of an old hernia and the symptoms of intestinal obstruction or strangulation, reduction *en masse* should be suspected.

**Symptoms and Diagnosis.**—On palpation the hernial ring is found to be enlarged, and often a tense globular mass can be felt just beyond the ring. There is fullness and tenderness of the lower abdomen on the affected side. Reduction *en masse* is followed by an aggravation in the symptoms of strangulation; the pain is more severe, the vomiting more frequent, abdominal tympanites is increased, and the diagnosis is reasonably certain. Whether the hernia has been reduced by simple taxis or by division of the constriction and reduction, the persistence of the symptoms of obstruction demands immediate operative intervention.

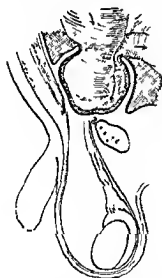


Fig 7

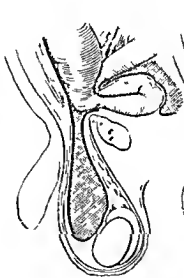


Fig 8



Fig 9

Fig 7—Reduction *en masse* following taxis. The hernial sac and contents have been reduced into the abdominal cavity.

Fig 8—False reduction *en masse* following incomplete rupture of the sac. The intestine is forced into the extraperitoneal tissues. Part of the sac remains in the scrotum.

Fig 9—False reduction *en masse* following complete rupture of the sac below its neck. The strangulation at the neck of the sac still persists. A portion of the sac is in the scrotum.

**Prognosis.**—The prognosis for reduction *en masse* is grave and the mortality rate is high.

**Treatment.**—When operating for a suspected hernia reduced *en masse*, a midline or lateral rectus incision should be used, especially if the hernia is of the femoral or obturator variety, or if there is a history of double hernia or two hernias of different types. There are cases on record in which opera-

tion showed strangulation at a site where a hernia was not known to exist. Sometimes a large inguinal hernia will cover up a small femoral hernia which reduces *en masse* when the voluminous inguinal hernia is reduced. With the midline or lateral rectus incision each hernial ring in turn is examined from within the abdomen. At the site of the strangulation a firm globular mass of variable size is felt and often the two portions of the intestine can be recognized at the point where they enter the sac.

The constriction is divided. By gentle traction the strangulated loop is withdrawn into the abdominal wound and dealt with as in ordinary strangulated hernia. A herniorrhaphy is done if the general condition of the patient is good; otherwise the repair of the hernia is left for a later time.

**Complications**—The complications following reduction *en masse* are the same as for ordinary strangulated hernia.

Severe intestinal hemorrhage sometimes occurs as a result of the trauma incident to reduction *en masse*. This hemorrhage often does not appear for one to two weeks after the operation as in the case reported by Harrison.

**Advantages of Operating Without Preceding Taxis**—The advantages of operating without preceding taxis are generally recognized and the low mortality rate is the best argument against taxis. Van Assen reported 100 cases of obstructed and strangulated hernia in patients who were operated on without preceding attempts at taxis. In this series there were only 2 deaths and both of these patients were in a critical condition when first seen. I believe that these excellent results were partly due to the fact that local anesthesia was employed in 62 cases.

### Operative Treatment for Strangulated Hernia

**Anesthetic**—As a rule local anesthesia is the anesthetic of choice for the operation of strangulated hernia. Patients with strangulation are always poor operative risks because of their lowered vitality, shock and prostration being more or less pronounced in every case. The patient's recuperative powers are impaired by the toxic products of the strangulated loop and when intestinal resection is necessary the prognosis is always grave even under the most favorable conditions.

The dangers of general anesthesia for strangulation are well known and statistics show that postoperative complications such as acute dilatation of the stomach, pulmonary nephritic and cardiovascular lesions are much more frequent than when local anesthesia is used. With general or spinal anesthesia the operation should be completed as quickly as possible.

**Preoperative Treatment**—The patient should be well wrapped and protected from undue exposure while being taken to the operating room. To minimize shock as far as possible the operating table should be thoroughly warmed by hot water bottles or electric pads and the patient should be kept warm throughout the operation. Transfusion and venoclysis are often needed as well as the Wangensteen suction tube to relieve the tympanites.

**Instruments**—Only a few instruments are necessary for the operation for strangulated hernia but a liberal assortment is an advantage in that it saves considerable time, and often permits the carrying out of a slight modification of the routine operation perhaps increasing the patient's chances of recovery. The necessary instruments are a pair of scissors, scalpel, two pairs of tissue forceps, six or eight pairs of hemostats, two retractors, a needle holder, a grooved director, straight and full curved round needles and cutting edged needles. Sutures should include plain and chromic gutgut and linen silk or cotton thread. Two Murphy buttons of different sizes should also be provided.

In emergency a safety razor blade makes a very good scalpel and retractors can be improvised by using bent spoons or by passing a long thread through the flap that is to be retracted and attaching a hemostat to it for a weight or having a bystander hold the thread. Intestinal clamps covered with rubber tubing are sometimes needed but if necessary the intestine can be tied off with a piece of narrow bandage passed through a small opening in the mesentery.

**Operation**—The operation for strangulated hernia is usually an emergency operation and often has to be performed in the patient's home under unusual difficulties. Every physician should be able to perform it as a life saving measure. Only a fair surgical knowledge is required, only ordinary instruments are needed and if the simple operative procedures are carried out under local anesthesia the mortality should be comparatively low.

The common mistake in operating on strangulated hernia is an attempt to do too much. It should be remembered that the object of the procedure is to save the patient's life and a two stage operation is better than a dead patient.

**Radical Operation**—Operation for strangulated hernia differs from operation for nonstrangulated hernia chiefly in the treatment of the constricting ring and in the management of the contents of the sac. (For the detailed technique of the operation for nonstrangulated hernia see the chapters on special hernias.)

In general the operation for strangulated hernia may be described as follows:

1 **INCISION**—The incision is made over the center of the tumor usually in its long axis and is longer than that for simple hernia. The subcutaneous tissues and fat are divided, bleeding vessels ligated and the sac is exposed and separated from adhesions for some distance on each side of the wound. Sometimes the tissues are swollen, discolored and edematous and it is necessary to divide them cautiously. The sac can be recognized by its gray or purplish color.

2 **OPENING THE SAC**—The possibility of a sliding hernia of the intestine should always be excluded before the sac is opened so that the bowel wall will not be incised in mistake for the sac. The serous covering of the intestine is smooth and glistening and if it is examined carefully it is seldom mistaken for the sac.

The sac is opened at a point as high as possible where it is not adherent to the underlying viscera. It is picked up with two mouse toothed tissue forceps or hemostats and carefully opened between them with a scalpel or a pair of scissors. The incision is enlarged and some fluid is ordinarily found in the sac. If this fluid is a clear serous exudate it usually means that the changes in the intestine are not far advanced; if it is dark red or brown and has a fecal odor, gangrene has developed.

The strangulated loop of intestine is located. If the hernia is very small precaution must be taken to prevent the loop from retracting into the abdomen when the constriction is relieved. Should the loop slip into the abdomen the intestine must be drawn back into the wound and examined. This accident is to be guarded against especially in enterocoele. The strangulated intestine is covered with compresses or towels wrung out of hot (115° F) sterile water or saline solution while the constriction is being located and relieved.

**3 DIVISION OF THE CONSTRICTION**—At the present time strangulated hernia is always treated by the open operation. The incision in the sac is carried up to the constriction which is exposed by retracting the edges of the wound and displacing the contents of the sac downward or to one side. The constriction is cautiously divided in plain view by nicking it with a scalpel or pair of scissors the intestine being protected by the index finger or a grooved director. Often time will be saved by opening the peritoneum an inch or two (2.5 or 5 cm.) above the constriction and dividing the latter on a director or on the index finger.

If the hernia is large and omental adhesions are extensive additional constricting bands should always be looked for in the sac and the possibility of a bilocular sac as well as the presence of a second strangulated hernia in another region should be thought of.

*Division of the Ring*—Doyen believed that it is often easier to divide the constricting ring by means of a pair of long bladed forceps than to cut it.

**4 EXAMINATION OF SAC CONTENTS**—The intestine is drawn into the wound and carefully examined.

*Signs of Viability*—The intestine is usually viable when its color returns promptly after division of the constriction or after the application of hot compresses for fifteen to thirty minutes. Other signs of viability are absence of clotting in the mesenteric vessels, the presence of arterial pulsation, bleeding when the mesentery is incised at different points even though arterial pulsation is absent and a smooth and glossy appearance of the intestinal serosa.

*Test for Viability of Strangulated Intestine*—The viability of the intestine can be established immediately by the fluorescam test advocated by Herrlin, Glasser and Lange. Another method is to inject procaine hydrochloride along the vessels leading to a strangulated loop of intestine. Vascular and muscular contractions follow if the intestine is viable and a restoration of circulation is hastened.

Deep inhalations by the patient of 100 per cent oxygen is a simple method for determining viability of strangulated intestine.

*Signs of Gangrene*—The intestine is usually gangrenous if the color does not return if the mesenteric vessels are thrombosed, if there is no arterial pulsation and no bleeding when the mesentery is incised, when the intestine is rough lusterless has lost its polish is collapsed and feels like wet paper, or when it is thin and friable and feels as though it would break if it were bent.

Before returning the viable loop to the abdominal cavity it should be drawn down and the entire intestine examined for a distance of a few inches above the constriction for raw spots ulcerated areas and minute perforations. The groove caused by the constriction is usually deepest on the posterior surface of the intestine where the pressure has been greatest and this area is inspected carefully. The vessels of the mesentery are examined for pulsation if it is absent or if there are thrombotic areas it is unsafe to reduce the intestine as it will not survive.

*Congestion Due to Traction*—If the color does not return to the intestine it is sometimes due to traction on the mesentery. To exclude the possibility of this cause the intestine is held for a few minutes near or within the peritoneal opening so that the mesentery lies loose and is free from tension. When the intestine is viable the circulation quickly returns.

*Leaving Suspicious Intestine Outside of the Wound*—If the pulsation in the vessels is very feeble and the color improves only slightly with the application of hot compresses the viability of the intestine is doubtful and it is sometimes advisable to leave the suspected loop in the wound and cover it with warm, moist petroleum jelly coated sterile dressings for a period of twelve to twenty-four hours. If the color does not return under this treatment the intestine is gangrenous if the color returns the loose plastic adhesions can be readily broken down and the intestine replaced in the abdominal cavity without anesthesia or after a simple local anesthesia infiltration of the muscles and skin the intestinal serosa being insensitive.

When intestine of doubtful viability is returned to the abdominal cavity it should be covered with a piece of omentum whenever possible, as a precaution against postoperative perforation. Garcey gives 30 cc of heparin parenterally when in doubt about the viability of the gut. His results have been excellent.

*Omentum*—When the omentum accompanying the intestine is in good condition it should always be returned to the abdominal cavity. Statistics show that omental resection adds slightly to the mortality rate in both strangulated and nonstrangulated hernia operations. When the omentum is inflamed strangulated or irreducible it should be resected by multiple interlocking ligatures each bite including not more than one quarter of an inch (6 mm). If the omentum is extensively adherent to the sac considerable time will be saved by ligating it at the neck of the sac without attempting to separate the adhesions and removing the adherent omentum along with the sac.

*Ligation of Mesenteric Vessels*—I want to emphasize the importance of freeing the mesenteric vessels from all other tissues before ligating them to avoid leaving masses of necrotic mesentery which are liable to become infected and suppurate. When the omentum is irreducible, on account of a small hernial



ring it can sometimes be returned to the abdomen if the neck of the sac is first freed all the way around for a distance of one half to one inch (1.25 to 2.5 cm) inside the internal ring. If this maneuver fails the omentum should be ligated in sections with each ligature at a different level otherwise it may be difficult to return the omental stump to the abdominal cavity.

It is better to excise the omentum in multiple ligations than in a mass ligature, so as to preserve the spreading relationship to the intestines and also to lessen the danger of embolism and thrombosis.

**5 TREATMENT OF GANGRENOUS INTESTINE:**—The treatment of gangrene depends on the amount of intestine involved and the condition of the patient. If the gangrenous area is small one half inch (1.25 cm) or less it can be inverted into the intestine and the healthy serosa sutured over it (Fig 10) if it is long and narrow and most of the circumference of the intestine is involved the necrotic strip can be invaginated into the lumen of the intestine and the healthy layers of serosa sutured together producing a partial intussusception. A piece of omentum when available should be tacked over the suture line.

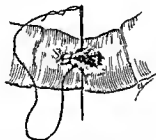


Fig 10—Inversion of a small circumscribed gangrenous area. If the intestine has perforated a second row of sutures or an omental flap should be used to reinforce the suture line. This method is not suitable when the gangrenous part exceeds  $\frac{1}{2}$  inch (1.25 cm) in diameter on account of the danger of postoperative stenosis of the intestine.

When gangrene is extensive there are two methods of treatment immediate primary resection of the gangrenous intestine and the formation of an artificial anus.

**Primary Resection**—Primary resection of the intestine is the treatment of choice and should always be employed when possible as both the immediate and the late mortality rates are lower with it than with the artificial anus operation. When the strangulation is high up in the small intestine resection is almost imperative because if an artificial anus is made the patient soon dies from inanition unless the opening is promptly closed by a second operation.

The three principal methods of resection that are applicable to the treatment of strangulated gangrenous intestine are (1) anastomosis with the anastomotic button, (2) lateral intestinal anastomosis and (3) end to end or end to side anastomosis. When time permits the method of choice is to close the divided ends and do a lateral anastomosis, end to-side anastomosis is the second choice and finally end to end anastomosis is indicated when it is impossible to bring the intestine up into the wound. In cases of extreme urgency the anastomotic button should be employed or an artificial anus should be formed.

*Application of Intestinal Clamps*—A clamp with light elastic blades covered with rubber tubing is applied to the intestine about two inches (5 cm) above the proposed line of resection. The intestine, including the gangrenous area is emptied of its contents as thoroughly as possible and a second rubber clamp is applied to the intestine about two inches (5 cm) below the proposed lower line of resection. An ordinary long bladed forceps is applied at the upper limits of the gangrenous area and another one just below the gangrenous area. These forceps prevent fecal extravasation when the gangrenous intestine is cut away.

*Resection of the Mesentery and Intestine*—The triangular portion of mesentery which lies between the proposed points of intestinal resection is cut away, leaving as much blood supply as possible. A cobbler's stitch is a rapid and efficient method of closing the mesentery. After all bleeding points have been ligated the gangrenous intestine that lies between the two inner clamps is cut away. The margins of each portion of the severed intestine are picked up with fine forceps and held open while the mucosa is thoroughly cleansed with small sponges moistened with an antiseptic solution. Horsley called attention to the importance of cleansing the mucosa in this manner to lessen the danger of fecal leakage after end to end anastomosis.

*Emptying the Affluent Loop*—The distended afferent loop of bowel that lies above the constriction should always be emptied. The gas is removed by puncturing the distended intestine with a large hypodermic needle the contents of the intestine are stripped back on pursestring suture introduced and an opening made inside of the suture just large enough to admit a Paul Moyrihan or Keith drainage tube or an ordinary one half inch (1.25 cm) glass tube if nothing else is available. One end of the tube is heated in a flame and the end flared out by inserting a forceps and spreading the blades. In an emergency a piece of stiff rubber tubing can be used. The tube is pushed up into the intestine as far as possible and held in place by tying the pursestring suture. A long rubber hose is attached to the tube and the intestinal contents are allowed to drain while the operation proceeds. (Fig 11)

*The intestinal contents of strangulated hernia are highly toxic and if allowed to pass through the intestinal canal they are absorbed increasing the toxemia that is already present. This routine emptying of the afferent loop lowers the mortality of strangulated hernia from 25 to 50 per cent.*

*1 The Anastomotic Button*—The anastomotic buttons most generally used are those devised by Murphy and by Jaboulay. Moynihan's absorbable bobbin is also popular. Intestinal anastomosis with the anastomotic button provides a quick simple and fairly safe method of uniting the resected ends of the intestine. It is especially valuable when the operation must be performed rapidly and when it is impossible to bring the intestine up into the wound. The Murphy and Jaboulay buttons are made in two shapes oblong and round. The round button is most frequently used for end to end anastomosis.

After the clamps are applied and before the gangrenous intestine is cut away a pursestring suture of the serous and muscular layers is made entirely around the circumference of the intestine at the proposed points of anastomosis.

The gangrenous intestine is cut away; one end of the button, lightly held by a mosquito forceps, is passed into the intestine, and the pursestring suture tied. The procedure is repeated at the other end of the resected intestine, and the two ends are forced together. Care must be taken that no mucosa is caught between the two layers of serosa. The opening in the mesentery is closed by interrupted sutures and the anastomosis is reinforced with interrupted sutures of linen or chromic catgut which penetrate only the serous and muscular layers

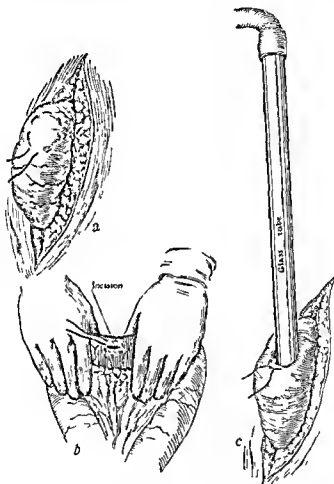


Fig. 11—Emptying the afferent loop in the treatment of strangulated hernia.

- a A purse-string suture is placed around the site of the incision in the intestine.
- b The intestinal contents are stripped back, and the intestine is opened by a short incision within the purse-string suture.
- c The drainage tube is introduced through the opening and the purse string suture tightened and tied to prevent leakage. Emptying the afferent loop greatly lowers the mortality in strangulated hernia operations.

of the intestine. When either end of the anastomotic button fits tightly into the intestinal segment, it should not be used on account of the danger of necrosis and peritonitis, or of obstruction. (Fig. 12) The button causes a pressure necrosis and becomes free in two to three weeks, when it is passed by rectum.

In isolated instances the button has caused intestinal obstruction. When the large intestine is involved, the oblong button is ordinarily used and the anastomosis is made by lateral approximation, the openings in the intestine being made at a point opposite the mesentery.

**2 Lateral Anastomosis**—When intestinal anastomosis is required and it is necessary to perform the operation rapidly a lateral or side to side anastomosis is quicker and safer than the end to end method.

The gangrenous intestine between the double clamps is cut away. The open ends of the intestine are closed in the following manner: for small intestine it is sufficient to clamp the intestine, apply a strong ligature, invert the stump and apply a pursestring suture to the serosa; for large intestine the ends are closed most securely by first applying a continuous suture of chromic catgut followed by a serous suture of linen.

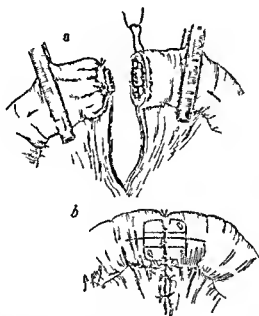


Fig. 19.—Anastomosis with the Murphy button.

a The half of the button with the smaller stem is placed in the afferent loop and the half with the larger stem introduced into the efferent loop. The purse string sutures are being tied.  
b The ends of the button have been forced together, the closure reinforced with a row of interrupted sutures and the edges of the mesentery stitched together.

With the ends closed lateral rubber covered clamps are applied so that a lateral segment of the bowel, three to four inches (7.5 cm. to 10 cm.) long and half the circumference of the intestine is caught in the bite of the clamps. The segments are placed side by side with their stumps at opposite ends so as to interfere as little as possible with the subsequent establishment of peristalsis. The anastomosis is facilitated by the use of a three bladed clamp to approximate the lateral segments of the bowel.

Two layers of continuous sutures are inserted in the following manner. The first half of the outer suture is applied parallel to the mesenteric border of the segments and close to it. This stitch is a continuous Lembert, or right angle stitch of chromicized catgut No. 0, linen or silk. The suture passes through

the serous muscular and submucous coats of the intestine. When the first half of the outer suture is completed the ends are tied and left long without removing their needles and are covered with a compress or towel while each segment of intestine is incised longitudinally on its free surface opposite the mesentery. These incisions in the intestine are about one quarter of an inch (6 mm) shorter than the first half of the outer suture. The opened intestinal segments are carefully cleansed with moist antiseptic compresses.

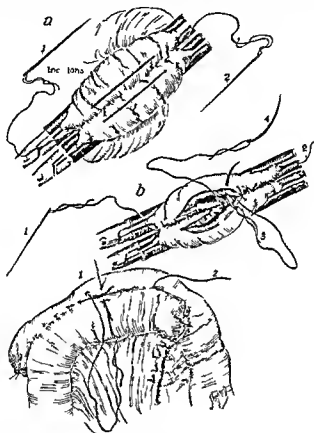


Fig. 13—Lateral intestinal anastomosis.

a The ends of the intestine have been closed, the rubber covered clamps applied, the loops approximated and the first half of the continuous suture completed (threads 1 and 2). The black lines show the position of the intestinal incisions.

b The intestinal incisions have been made and the through and through suture is nearly half completed (threads 3 and 4). The loop of the suture is on the inside so as to invert the edges when the stitch is tightened.

c The through and through suture is now completed and the clamps removed. The continuous suture (threads 1 and 2) is completed. The cut edges of the mesentery are stitched to the side of the wall of the intestine with interrupted sutures.

The cut edges of intestine are united by the inner suture which is a continuous right angle stitch of chromic catgut No. 0 linen or silk that passes through all the coats of the bowel from mucosa to serosa and from serosa to mucosa. This suture is begun in the middle of the wound uniting the inner edges of the intestine and is continued halfway around the circumference of the wound. With a needle on the other half of the suture the remaining half of the opening

is sutured, and the ends are tied together on the mucous side. This stitch must be snug enough to prevent leakage but not tight enough to produce necrosis.

The intestinal clamps are removed, and the remaining half of the outer stitch is completed, and tied in the middle, so as to give a tight closure of the corners. The suture is cut close, and the angle formed at the junction of the mesentery and intestine is closed with a few sutures of No. 0 chromicized gut, linen or silk. (Fig. 13.)

*Anastomosis Above the Strangulation*—When the condition of the patient is grave, a lateral anastomosis above the strangulation is sometimes advisable. If the strangulated loop cannot easily be drawn down into the wound, a low lateral abdominal incision is made, the healthy intestine anastomosed above the strangulation, the necrotic loop cut away or left undisturbed in the sac and the wound left open. Because the anastomosis is against the peristaltic current the resultant fistula does not close as quickly as when the anastomosis is with the current. However, there is little danger of leakage in the suture line and the fistula usually closes spontaneously in a few weeks' time. I have had good results with this method in serious cases. (Fig. 14.)

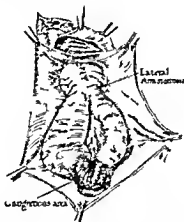


Fig. 14—Intestinal anastomosis above the strangulation. When the condition of the patient will not permit the ordinary resection it is sometimes possible to pull healthy intestine down into the sac and do an anastomosis. The necrotic loop can be cut away or allowed to remain in the sac and the wound left open.

*3 End to End Anastomosis*—For end to end anastomosis the intestinal ends at the proposed point of resection are cut obliquely, usually 30 to 45 degrees less than a right angle. By cutting the intestine obliquely, the mesenteric portion is longer than the part opposite the mesentery. Thus the intestine is assured of a good blood supply and there is also less danger of postoperative narrowing of the intestinal lumen than when the intestine is divided at right angles. The cut ends of the intestine are thoroughly cleansed with moist pledgets of gauze.

A long suture 12 to 15 inches (30 to 37.5 cm.) of chromicized catgut No. 0 linen or silk, is threaded on a straight round (a milliner's needle is best) needle and a mattress mesenteric stitch applied in the following manner. The needle is passed from within outward about one eighth of an inch (3 mm.), just to one side of the mesenteric border. It passes through the mucosa into the con-

nective tissue of the mesenteric angle, emerging through the peritoneum at the mesenteric intestinal junction. From this point the needle passes across to the opposite segment of intestine where it penetrates the peritoneum and mucosa. Here its course is reversed and it returns on the opposite side of the mesentery to the starting point, where the ends are tied and cut. The cut ends of the intestine are folded back with the serous surfaces in contact, so that they look like a double barreled gun. A fine linen or silk suture is passed from the serosa to the mucosa of one segment, and returned through the mucosa and serosa of the other segment. The suture is tied and left long to be used as a traction thread. A second suture is passed through all the coats on the opposite side of the mesenteric angle, so that the distance between the two traction threads is about one third of the circumference of the intestine. While traction on these threads approximates the cut edges the first thread is used as a continuous suture until it reaches the second thread, when a third traction suture is introduced at a point midway between the first and the second ones. The continuous stitch unites the intestinal edges lying between the second and third traction threads.

The second traction thread is now removed and the last third of the intestinal suturing is completed while the edges of the intestine are approximated by pulling on the first and third traction threads. The last stitch emerges through the serosa and is tied to the end of the first stitch. Some operators tie this suture on the inside of the intestine in order to provide equal tension while applying the continuous suture.

It is a good plan to take a back stitch every third or fourth stitch to lock the thread and prevent it from slipping. A second row of sutures is applied uniting the serous surfaces of the bowel segments. If time permits, interrupted Lembert sutures should be used for the second tier. When the operation has to be done hurriedly, Cushing's parallel continuous stitch can be employed.

The first stitch of the second row is placed opposite the attachment of the mesentery to the intestine and left long to act as a traction thread. If interrupted sutures are used, it is a good plan to insert two more traction threads at equidistant points along the circumference of the bowel. (Fig 15.)

*End-to-End Anastomosis With the Basting Stitch*—The basting stitch method of intestinal anastomosis is not to be recommended for routine use. However, it is very simple to execute, and because it is quicker than the method just described, it is suitable in certain cases where the intestinal lumen is not too small. When an assistant is not available to hold the basting threads the intestinal suture staff which has been made for me by the Kny Scheerer Co. is invaluable. This staff has four buttons on each side placed at convenient intervals, so it can be used for the stomach, small or large intestine. One or two turns around a button will hold the thread securely.

The basting stitch method is as follows. A thin narrow bladed clamp is applied obliquely to each segment of intestine which is then divided with a cautery, flush with the clamp. Each end of intestine is temporarily closed with a basting stitch which consists of a continuous right angled suture without knots, applied very close to the outer side of the forceps blade as shown in the illustration. I use fine linen or silk for this basting thread.

The basting thread is tightened as the clamp is removed automatically inverting the edges of the intestine along its entire circumference. After both basting threads are tightened their ends are secured by one or two turns around convenient buttons on the staff. With the intestinal segments side by side a serosa muscular suture is easily and quickly placed—an interrupted Lembert or a continuous right angled stitch entirely around the circumference of the intestinal segments. The staff is removed the basting stitch pulled out the mesentery sutured and the anastomosis reinforced by a second row of sutures or a flap of omentum tacked over the sewn edges. (Fig 16)

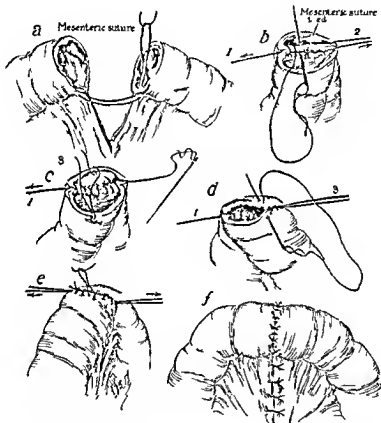


Fig 16—End-to-end anastomosis

a The intestinal ends are cut obliquely and the mattress mesenteric stitch has been placed and is ready to be tied

b The mattress mesenteric suture has been tied. The first traction thread is passed and tied (thread 1) the second traction thread is also inserted and tied (thread 2) and the intestinal ends are stitched together with a continuous through and through suture (thread 1)

c The third traction thread is inserted (thread 3) and the through and through stitching continued (thread 1)

d The second traction thread has been removed. The last third of the anastomosis is being closed with the through and through suture

e The first row of suturing is completed. Two traction threads have been inserted and the reinforcing serosa sutures have been started

f The intestinal anastomosis completed and the mesentery closed

If the openings in the intestine are unequal the larger one is gathered or puckered on the basting thread so that it corresponds to the smaller one. I have used the method for gastroenterostomy



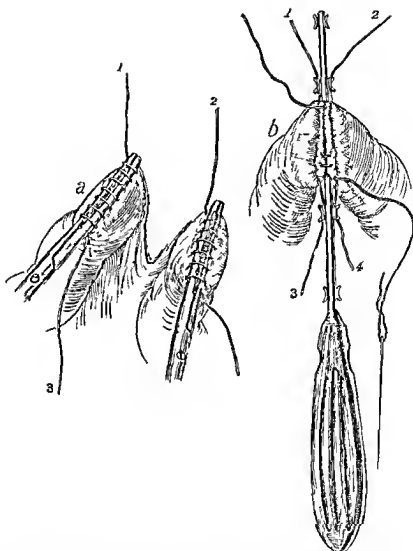


Fig. 16—End to end anastomosis with the basting stitch. (Author's suture staff.)

*a* Thin narrow bladed clamps have been applied obliquely to the intestine and the latter divided with a cautery flush with the site of the clamps. The basting threads have been placed around the buttons of the intestinal suture staff. The first half of a continuous right angle serosa muscular suture has been inserted. The suturing completed the staff is removed and the basting thread pulled out and a second row of reinforcing sutures are applied.

The principal objection to the basting stitch method is that it leaves more tissue in the lumen of the intestine than the ordinary suture method just described, and for this reason there is probably greater danger of postoperative narrowing of the lumen. To lessen the danger of stenosis, the turned in edge should be as narrow as possible. Valuable papers on this method of anastomosis have been published by Parker and Kerr, and Trueblood.

**Combined or Double Operation for Strangulated Hernia**—When gangrenous intestine is found in the hernial sac, and the condition of the patient is good, it is sometimes a good plan to open the abdomen through a lateral rectus incision and anastomose the afferent and efferent loops above the hernial ring, by means of an anastomotic button. The gangrenous bowel is fastened in the wound, and when the necrotic area sloughs open it is treated as a fistula. Healing is much quicker than after the ordinary operation for artificial anus. This operation has given a very low mortality in the hands of Estapč. When the patient's condition does not justify the opening of the abdomen, it is often possible to draw the loops down in the wound and do an anastomosis above the gangrenous area, and fasten the intestine, at the site of anastomosis, to the neck of the sac.

**Artificial or False Anus**—An artificial anus should be formed when the patient's condition does not warrant a more extensive operation. This emergency procedure is most suitable for strangulated hernias of the descending colon or sigmoid. The constricting ring is divided and the strangulated loop drawn down until the healthy intestine of both the afferent and the efferent loops is in the wound. The healthy serosa of both loops is sutured to the parietal peritoneum, as high as possible above the hernial ring, by means of a continuous Lembert suture of chromic gut.

The gangrenous portion of the intestine is cut away, and a glass tube or a stiff rubber tube is tied into the distended afferent loop to drain off its septic contents. The resected ends of the intestine are walled off from the peritoneal cavity by gutta percha or rubber dam. Oiled paper can be used in an emergency. A voluminous, stuffed gauze dressing is applied, and changed frequently for the first day or two. The drainage tube can be removed as soon as firm peritoneal adhesions are established, which is in two or three days.

The after treatment consists of keeping the skin as free from irritation as possible by the application of petroleum jelly or, better still, a thick paste of zinc oxide and castor oil. If the patient survives this emergency operation, the intestinal opening gradually decreases in size, terminating in a fecal fistula which sometimes closes spontaneously in a few weeks or months, however it is usually necessary to close it by a second operation.

**Treatment of Fecal Fistula**—A fecal fistula that does not close in a short time becomes a drain on the patient's strength, and for this reason it is often necessary to close the opening by surgical means. Haggard stated that sometimes the fistula will close spontaneously if it is freed by a circular incision from the fascial edges of the opening. Coffey closed the fistula by indirection. After freeing and dissecting out the fistulous tract, the skin margin is cut off, the edges

of the fistula are turned in with linen sutures which are knotted on the inside. The wound is closed in layers and a drain placed in each end of it.

**Gangrene of the Hernial Coverings**—An unusual case of gangrene of the abdominal wall complicating gangrene of the cecum, ascending and transverse colon and the splenic flexure of the descending colon in an umbilical hernia was reported by Buchanan. He excised the gangrenous mass, implanted the ileum into the wall of the sigmoid and the patient recovered.

### Postoperative Treatment of Strangulated Hernia

The after treatment of strangulated hernia consists in measures to combat shock, collapse and toxemia. The patient should be kept warm and saline solution or plain water given by rectum using the drip method or it can be given by hypodermoclysis. The Wangenstein suction tube is used for tympanites, blood transfusion is given, glucose and alkalis are used to combat acidosis, glucose 2 per cent and sodium bicarbonate 1 per cent are administered by the Murphy drip method or by enema 4 ounces every two to six hours. Intestinal paresis should be treated with pituitrin hypodermically.

If local anesthesia has been employed the patient can take whatever liquid food he will immediately after the operation provided the intestine has not been resected. If he is very feeble the early resumption of food is sometimes a lifesaving factor. A cathartic should not be administered as a rule for a few days after the operation because the increased peristaltic movements might cause a break in the suture line possibly resulting in a fatal peritonitis.

When the intestine has been resected rectal alimentation is used for four to six days and a liquid diet by mouth until the tenth day when light diet can be given. The dressings should be changed regularly. (For additional details on postoperative treatment, see the chapters on special hernias.)

### Strangulated Hernia in the Aged

Strangulated hernia in the aged should be treated by operation under local anesthesia without preceding attempts at taxis.

Elderly patients should be turned in bed often beginning a few hours after operation. The administration of fluid should be forced and nourishment resumed as soon as possible. Old people do not stand confinement to bed. They should have a back rest on the second or third day after operation and the following day they should be gotten into a chair. Often these patients die from being kept in bed too long.

### MORTALITY RATE FOLLOWING OPERATIONS FOR HERNIA

The mortality rate following the operation for hernia is highest in the umbilical variety, lower in the inguinal and lowest in the femoral variety.

**Nonstrangulated Hernia**—In nonstrangulated hernia the death rate is lowest in children and highest in the aged. The mortality rate for nonstrangulated inguinal hernia in children is probably about one per cent, it varies from

0.15 to 3 per cent in different clinics. In 2672 operations in infants and children collected from ten clinics there were 29 deaths a mortality rate of 1.08 per cent.

In adults the mortality rate for nonstrangulated inguinal hernia is approximately 0.5 per cent. It is about 1 per cent in femoral hernia, and probably 3 to 5 per cent in umbilical and ventral hernia in obese or elderly subjects.

In 6000 operations for nonstrangulated hernia collected from 15 clinics there were 62 deaths or 1 per cent.

**Strangulated Hernia**—Simple reduction of the intestine before gangrene develops has the most favorable prognosis. When there is gangrene the mortality is lowest when only omentum is involved, higher when resection of small intestine is required, and highest when partial excision of the colon is necessary.

The mortality rate in strangulated inguinal hernia depends largely on the duration of the strangulation before operation and whether or not the intestine has become gangrenous. When operation is performed in the first twelve hours the mortality rate is about 5 per cent, within twelve to twenty-four hours 10 per cent, and within twenty-four to forty-eight hours 20 per cent.

In femoral hernia the mortality rate is somewhat higher and in the umbilical and ventral varieties it is nearly twice as high as in inguinal hernia.

**Duration of Strangulation and Mortality**—The mortality rate of strangulated hernia is in direct proportion to the duration of the strangulation.

DURATION OF STRANGULATION

	LESS THAN 24 HR.	24-48 HR.	48-72 HR.	72-96 HR.
Ming	4.76	11.8	28.5	75
Henggeler	8.09	22.2	45.5	60
Iuka		17.6	40	
Frickhoffer		19.4	45	50
(1822-58)				
Gussow	5	40	41	44
Alexander	1 12 hr. 5	11	76	
	12 24 hr. 28			

**Strangulated Hernia in Infants**—Lator studied 202 strangulated hernia operations in infants and found a mortality rate of 32 per cent for the preantiseptic period and 11.4 per cent for the antiseptic period, which dates from 1885.

**Strangulated Hernia in Preantiseptic Days**—In preantiseptic days when strangulated hernias were operated on only as a last resort the mortality rate was very high. Textor stated that in a series of 56 kelotomies for strangulated hernia at Wurzburg between 1816 and 1842 there were 24 deaths (48 per cent). Husson collected the records of 227 patients who were operated on in the hospitals of Paris between 1861 and 1864 and found a mortality of 74 per cent. Gosselin performed kelotomy without prolonged attempts at taxis with a mortality rate of only 49.9 per cent.

When the intestine is gangrenous and it is necessary to resect it or to form an artificial anus the mortality rate is very high, from 20 to 40 per cent. The mortality rate for strangulated hernia is still much too high. It can be lowered

by early diagnosis, prompt treatment, a more general adoption of the two stage operation in gangrenous hernia in the seriously ill patient, and the routine use of local anesthesia

## EMBOLISM AND THROMBOSIS

Embolism and thrombosis sometimes complicate hernia operations or ill advised attempts at taxis. They usually occur in middle or advanced life.

**1 Pulmonary Thrombosis**—Pulmonary thrombosis seldom occurs before the first week after operation, usually between the tenth and fourteenth days. The mortality rate is high. This complication has been almost eliminated by early ambulation after operation.

**Symptoms**—The symptoms of pulmonary thrombosis come on without warning, and death may be almost instantaneous. However, the patient usually lives a few minutes, he cries out complaining of suffocation and severe pain over the heart. If obstruction to the blood is not complete he may live several hours with rapid breathing and marked dyspnea and cyanosis.

Several years ago I operated on a man fifty years of age, for right inguinal hernia. There were extensive omental adhesions in the sac, but no omentum was excised. Recovery was unsuccessful until the sixth day, when he suddenly developed symptoms of pulmonary thrombosis and died within five minutes.

**Treatment—Preventive Measures**—The principal preventive measures for pulmonary thrombosis may be summed up as follows. The tissues should be handled very gently during the operation, rough retraction should always be avoided, the veins in the field of operation should be ligated carefully and injury to their intima painstakingly avoided, hemostasis should be complete before the wound is closed, the patient's knees should not be bent while on the operating table, because the slowing of the blood stream is an important etiologic factor, and for this same reason, patients with severe anemia should receive a blood transfusion before operation, local infection is unquestionably an important cause hence absorption areas should not be opened up any more than is necessary during the operation. Most important of all, is early rising after operation and active exercise for hernia patients, to be carried out while they were still in bed to speed up the circulation.

**Operative Treatment**—Only a few instances are recorded in the literature in which an attempt has been made to remove a pulmonary or femoral embolus by operation.

**2 Mesenteric Thrombosis**—Mesenteric thrombosis is often associated with arteriosclerosis, and the most important causative factors are probably disturbances in the blood supply, trauma and local infection. Mesenteric thrombosis may be venous or arterial. Venous thrombosis gives more indefinite symptoms and its progress is slower than arterial thrombosis in which the symptoms often resemble those of acute intestinal obstruction. Venous thrombosis has a greater tendency to spontaneous cure than arterial thrombosis.

**Treatment**—Immediate operation is indicated when mesenteric thrombosis is suspected. If the mesentery is gangrenous, resection of the intestine is

necessary. If the patient's condition is critical the intestine can be left in the wound, a glass drainage tube inserted, and the intestinal contents allowed to drain.

**3 Hematemesis**—Hematemesis sometimes follows the excision of a large mass of omentum and should always be borne in mind, as emphasized by Langley.

### PREVENTION OF ABDOMINAL ADHESIONS

A number of methods have been devised to prevent abdominal adhesions. As the formation of adhesions is a part of the normal process of healing, substances to prevent their development should never be used as a routine. When it is necessary to use something to lessen the formation of adhesions, the best substance is a mixture of gelatin 2½ per cent, gum acacia 2½ per cent, and water 50 per cent.

Other helpful measures are gentle handling of the viscera, protection against drying of the serosa from exposure to the air by keeping all exposed viscera covered with gauze saturated with warm moist normal saline solution, and the avoidance of all sponging of intestine, mesentery or omentum with dry gauze. Omental grafts are valuable for covering raw surfaces when the wound is sterile, but must never be used if there is infection. The section of nerves when the lateral rectus or other muscle-cutting incision is used, may favor the formation of adhesions.

### SHOCK

All patients with strangulated hernia suffer more or less from shock. Consequently, preoperative as well as postoperative treatment is of the utmost importance. The chief factors in combating it are as follows: rest in bed with the foot of the bed elevated, and an abundance of fluids, such as a solution of 1 per cent sodium bicarbonate and 2 per cent glucose solution per rectum by the drip method, or 2,000 to 3,000 c.c. of warm normal saline solution every twenty-four hours by hypodermoclysis or by intravenous infusion. If intravenous infusion is employed, it is sometimes a good plan to add 5 grams of gelatin and 2 grams of ascorbic acid to each 1,000 c.c. of the saline solution. In most cases a blood transfusion both before and after operation is advisable. The conservation of body heat is important and is secured by wrapping the patient in hot blankets and placing hot water bottles or bricks around him. To prevent the spread of peritonitis, he should be placed in the Fowler position, and if there is no contraindication to morphine, small doses are valuable. Sequestration anemia is very useful, and it is induced by bandaging the lower extremities, and in severe cases the upper extremities also—this procedure raises the blood pressure and provides more blood for the brain, thoracic and abdominal cavities.

The choice of anesthetic is of paramount importance. Local or spinal anesthesia should be used whenever possible. Nitrous oxide is the second choice. If general anesthesia is employed, the entire line of incision should be blocked by local anesthesia to minimize the shock, and the operation completed

as quickly as possible. Loss of blood and body heat must be prevented, the dissection should be as gentle as possible, and the simplest and quickest operation must be used.

## POSTOPERATIVE TREATMENT

The Wangenstein suction tube prevents acute dilation of the stomach and adds much to the patient's comfort for two to four days postoperatively. A low rectal tube or catheter should be passed and left in the rectum to carry off gas accumulation in the sigmoid colon.

The postoperative treatment of strangulated hernia should include the breathing of 100 per cent oxygen to help displace by diffusion the nitrogen contained in the distended or strangulated bowel. Blood transfusion and physiologic salt solution should be used to replace loss of blood cells and minerals by vomiting or otherwise.

An impaired circulation or damaged myocardium is benefited by a 50 per cent dextrose or glucose solution, giving 100 to 200 cc by venoclysis twice daily, before and after operation. The addition of some form of chloride is also helpful. Penicillin, 20,000 units parenterally every three hours one day before operation and two days postoperatively, is advisable to combat infection. If administered orally, the dosage should be tripled.

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## CHAPTER IV

### COMPLICATIONS OF STRANGULATION

The principal complications of *strangulated hernia* are *intestinal hemorrhage*, *stenosis of the intestine*, *postoperative perforation* and *volvulus of the intestine*. (The other complications are those associated with *nonstrangulated hernia* and are discussed in the chapters on *special hernias*.) Kraus in 1943 wrote on the subject and Reyes in 1943 published a monograph on the complications of strangulation.

#### INTESTINAL HEMORRHAGE (ENTERORRHAGIA)

Intestinal hemorrhage may follow attempts at taxis or the operative treatment of strangulated hernia. Schmitzler in 1894 called attention to the early appearance of enterorrhagia and Ullmann in 1897 described delayed or latent hemorrhage. Intestinal hemorrhage following strangulation is divided into two general types: (a) the avoidable hemorrhages due to trauma, taxis or intestinal perforation and (b) the unavoidable hemorrhages which are most conveniently subdivided into two varieties, namely, early intestinal hemorrhage and delayed or latent intestinal hemorrhage.

##### Early Intestinal Hemorrhage

Early intestinal hemorrhage usually occurs within the first twenty-four hours. It is seldom severe but it indicates low vitality of the intestine with arterial ischemia that is liable to be complicated further by arterial thrombosis.

**Etiology**—The generally accepted cause of early intestinal hemorrhage is a trophic disturbance in the capillaries. Following the onset of strangulation the arterial flow is checked in the constricted loop and the capillaries undergo trophic changes and become weakened. With the reestablishment of arterial circulation the diseased capillaries are unable to withstand the pressure and a rupture with hemorrhage takes place.

The principal causative factors of intestinal hemorrhage following strangulated hernia operations may be summarized as follows:

1. Ulceration of the mucosa resulting in the casting off of an eschar. This may occur occasionally at a distance from the point of constriction.
2. The rupture of the arterial capillaries as a result of the pressure in the arteries when circulation is resumed.
3. The collection of an exudate of blood between the layers of the intestinal walls often resulting from trauma or taxis.
4. The sudden dilatation of the mesenteric arteries as circulation is resumed after a temporary occlusion (Latten).
5. Thrombosis of the mesenteric veins causing congestion, edema and finally hemorrhage which is due to ulceration of the mucosa.

6 Thrombosis of the intestinal blood supply as a result of resection of the mesentery or the omentum

7 Diseases of the herniated viscera or of the peritoneum

8 Sympathetic reflex disturbances or vasomotor paralysis of the mesenteric nerves. This theory is of doubtful value

**Frequency**—Early intestinal hemorrhage is not encountered as frequently as delayed or late hemorrhage although it probably occurs much oftener than statistics show but is overlooked through failure to examine the stools or because of the fact that a small amount of blood may be digested without being recognized especially when the bleeding point is high up in the small intestine or perhaps small clots of blood may be intimately mixed with the feces and escape detection unless blood tests are made

**Symptoms**—The onset of hemorrhage is usually manifested by a slight elevation in temperature followed by the appearance of blood in the stools. The bleeding may continue for several days but is seldom profuse. When there is considerable hemorrhage the temperature is usually subnormal and there are other symptoms of shock. Profuse hemorrhage generally occurs in voluminous hernias of long standing. Strangulation is usually of short duration—twelve to twenty-four hours—and the strangulated loop is often long.

The recovery of the patient from the strangulated hernia operation is usually only slightly delayed by the hemorrhage although the statistics collected by Cistagnol indicate that the mortality is higher than generally supposed. When death occurs it is nearly always due to other causes such as volvulus perforation pneumonia etc.

### Delayed or Latent Hemorrhage

Delayed hemorrhage usually occurs between the fourth and sixteenth day after operation. As a rule the general condition of the patient up to this time is good and apparently he is nearly well when bleeding suddenly appears without prodromal symptoms and is often profuse. The outlook is serious.

**Etiology**—Delayed hemorrhage usually occurs in elderly subjects with arteriosclerosis. The mesenteric vessels become thrombosed and an extensive hemorrhagic infarct develops in the intestinal wall. This change in non-terminal intestinal arteries was demonstrated by Lutten. Bégouin produced late intestinal hemorrhage experimentally by ligating one of the small arteries supplying the intestine. The strangulation in cases of delayed hemorrhage is usually of long duration from three to four days according to Ullmann.

As early as 1866 Niclause demonstrated that intestinal gangrene progresses from the mucosa outward toward the serosa and this fact was more recently confirmed by the experiments carried out by Schweninger and Tietz. When intestinal wall feels thin and is of questionable viability it should be regarded as suspicious. The fact that the serosa is intact often causes the operator to replace damaged intestine.

The constricting grooves on the intestine show ecchymotic rings that denote the line of demarcation between the strangulated loop and the normal

intestine that lies within the abdominal cavity. Thinning of the intestine in the constricted groove should be suspected when the serosa is rough, lusterless and of grayish or dead leaf color.

It should be borne in mind that the bleeding sometimes takes place in the intestine above the point of strangulation within the abdominal cavity. If the ulceration involves the serosa perforation will follow, and the hemorrhage will appear in the peritoneal cavity. If the hemorrhage is high up in the intestine and is complicated by partial obstruction in rare instances the blood will be vomited.

**DIFFERENTIAL DIAGNOSIS BETWEEN EARLY AND LATE INTESTINAL HEMORRHAGE FOLLOWING STRANGULATION**

	EARLY HEMORRHAGE	LATE HEMORRHAGE
Time of onset	1-48 hours	4th to 10th day
Amount of bleeding	slight	sometimes profuse
Duration of strangulation	12-48 hours	3-4 days
Constriction	usually narrow	often wide
Size of hernia	frequently of long standing and voluminous	usually small
Age	a young or adult	usually in the aged associated with arteriosclerosis
Prognosis	favorable	grave

**Prognosis**—The prognosis of early hemorrhage is usually favorable because the amount of bleeding is small and it yields to palliative treatment. Delayed or late hemorrhage has a grave outlook because the bleeding is profuse and as the condition is generally found in elderly arteriosclerotic subjects, the chances of spontaneous cure are remote. When the stools contain *gangrenous scraps often grayish and fetid the hemorrhage will usually yield* to palliative measures provided the surgeon is certain he did not overlook a patch of gangrene in the serosa at the time of the hernia operation. Operative intervention is sometimes required and should be resorted to early before the patient is exhausted from loss of blood. Patients operated on *in extremis* usually die.

**Treatment**—When the hemorrhage is not profuse the treatment is usually palliative. A liquid or soft diet should be given to diminish peristalsis as much as possible. In severe cases nothing is given by mouth, all fluid and food being administered per rectum for several days after the blood has disappeared. To control the hemorrhage the patient is kept quiet for two to three weeks, an opiate given to check peristalsis, an ice bag applied over the abdomen, calcium chlorid solution given by hypodermoclysis and horse serum, ergotin or ergotol given hypodermically. If there is diarrhea it should be controlled by opiates to which a styptic has been added. After the hemorrhage is checked the bowels should be moved daily with a mild laxative or a low enema.

**STENOSIS OF INTESTINE**

**Stenosis of the Intestine Following Hemorrhage**—Stenosis of the intestine is sometimes a late complication of intestinal hemorrhage following

strangulated hernia operations. The cicatrix is situated at the site of the former ulcer and may not produce symptoms until several months after the hemorrhage.

**Stenosis of the Intestine After Strangulation**—Stenosis or stricture of the intestine resulting from strangulation is comparatively rare. Probably the first case was reported by Verel in 1772 and in more recent times Cotte and Leriche published their monograph.

**Pathological Anatomy**—The constriction of the intestinal wall is usually annular or tubular in form.

*1 Annular Constriction*—Annular constrictions are ordinarily single but when double they correspond to the two extremities of the strangulated loop of intestine. The constriction furrow is narrow and the serosa is rough, lusterless and grayish in color.

*2 Tubular Constriction*—Tubular constrictions are nearly always single and are due to ulceration and cicatrization of the mucosa. In severe cases the muscular layers are also involved and in rare instances the serosa may undergo cicatricial changes. Tubular constrictions may be 1 to 2 inches (2.5 to 5 cm) long and the lumen of the intestine may be the size of the little finger or in marked stenosis it may be so small as to admit only a probe.

**Changes in the Intestine**—The afferent loop of intestine above the stenosis is dilated and its walls are more or less hypertrophied, especially the muscular layers. Below the constriction the efferent loop is thin, atrophied and collapsed, very much the same condition of affairs being found here that is found in strangulation.

**Experimental Stenosis**—I have produced stenosis experimentally by ligating the arterial supply for a short time, always removing the ligature in less than two hours to prevent gangrene. Necrosis of the mucosa always developed with the ultimate formation of a stricture.

**Etiology**—Stenosis is much more frequent after strangulated inguinal hernia than after strangulated femoral hernia in spite of the greater frequency of strangulation in the femoral variety of hernia. Of 37 cases of stenosis collected in the literature by Jaboulay and Patel 27 were inguinal, 8 femoral and 2 umbilical.

Stenosis may be due to interference with the blood supply which results if an insufficient amount of mesentery is left when the intestine is resected or if the vessels supplying the intestinal wall come from the adherent omentum and are destroyed when the adhesions are separated. If too large an area of gangrenous intestine is inverted at operation for strangulated hernia stenosis is liable to result. Other causes are trauma, taxis pinching of the intestine by a truss, the presence of foreign bodies in the sac constricting bands adherent to the sac or abdominal wall or to other viscera, localized peritonitis, tuberculous mesenteric cysts and benign and malignant growths involving the intestine.

**Symptoms**—The symptoms of intestinal stenosis may appear any time after attempts at taxis or operation for strangulated hernia. The patient

usually does well for a few days after operation when he notices slight pains in the abdomen occasionally associated with vomiting and some distention of the abdomen. Sometimes the symptoms appear as early as twenty-four hours after operation or as late as several years after the strangulation.

There are two varieties of stenosis: acute and chronic.

**Acute Stenosis**—In acute occlusion the symptoms are marked. Vomiting becomes frequent, abdominal distention increases, the pulse is feeble, the temperature subnormal and breathing is labored.

**Chronic Stenosis**—In chronic occlusion the symptoms appear gradually, slowly increasing in severity, as in other forms of stricture of the intestine. There is vomiting when the stomach becomes distended. The patient suffers from inanition and steadily loses weight. The abdominal distention becomes distressing until relieved by vomiting or by gas passing the obstruction, the latter being accompanied by a characteristic sound on auscultation which Jaboulay and Patel have aptly compared to the glou glou sound of a bottle being emptied of liquid.

**Sign of Future Stenosis**—When the constricted loop is freed and inspected during an operation for strangulated hernia, the constricting groove or furrow should disappear if it is gently stroked with moist pledgets of cotton. Should the groove persist it usually means that the mucosa has been destroyed and more or less obstruction will develop later on.

**Prognosis**—The prognosis for stenosis of the intestine is unfavorable. The symptoms are temporarily helped by medical measures but tend to increase in severity as the stricture becomes tighter. Operative treatment is the only hope for relief and should be undertaken early before the changes in the affected intestine become too advanced and while the patient's general condition is good.

**Treatment**—Operative treatment is indicated in both acute and chronic stenosis. If the strictured portion of the intestine is very small it is sometimes possible to excise the fibrous tissue and do a plastic operation on the intestine. As a rule it is safer to resect the intestine well beyond the stricture and do a lateral or end-to-end anastomosis by suture. When the patient is a poor risk and a rapid operation is imperative, an anastomotic button should be used to join the intestinal ends.

When the stricture is due to adhesions, to extensive constricting bands to mesenteric cysts or to new-growths in adjacent viscera, it is useless to separate adhesions unless omentum is available to cover the raw surfaces. In these cases intestinal resection will give the patient the best results.

## POSTOPERATIVE INTESTINAL PERFORATION

Postoperative intestinal perforation may occur when intestine of doubtful viability is returned to the abdominal cavity. It may take place in the loop that has been strangulated or in the afferent loop above the constriction. The intestine may rupture as soon as it is returned to the abdominal cavity or several days afterward.

The resistance to bacterial infection normally possessed by the mucosa is impaired or destroyed by the trophic changes it undergoes during strangulation. If the infection is limited to the mucosa, an eschar is thrown off accompanied by more or less hemorrhage. If the entire intestinal wall is involved and it becomes necrotic, perforation results and is followed by peritonitis. Diagnosis is rarely made excepting at operation. The symptoms are the same as those associated with any form of intestinal perforation. When symptoms of peritonitis appear after a strangulated hernia operation, intestinal perforation should always be thought of.

**Perforation of Intestine Above the Constriction (Proximal Ulceration of Intestinal Obstruction)**—Perforation of the afferent portion of intestine above the constriction in the abdominal cavity is a rare complication of strangulated hernia. The circulatory and trophic changes of the afferent loop of intestine have been discussed under the pathology of strangulated hernia and also under the heading of intestinal hemorrhage.

**Prognosis**—If the intestinal rent is small and adhesions have time to form and localize the peritonitis the outlook is fairly good. Should the peritonitis become general the prognosis is grave and unless operation is resorted to promptly, the patient usually dies.

**Treatment**—The treatment for postoperative intestinal perforation is a prompt exploratory laparotomy. The rent in the intestine must be found and closed. The intestinal suture line should be protected by a flap of omentum if it is available the wound closed with drainage the patient placed in the Fowler position and treated for peritonitis.

## VOLVULUS OF THE INTESTINE COMPLICATING STRANGULATED HERNIA

Volvulus is a rare complication of strangulated hernia, and is almost always associated with inguinal hernia. However a few cases of the umbilical, obturator and femoral varieties have been reported in the literature.

**Anatomic Varieties**—Knaggs divided volvulus complicating strangulated hernia into four groups:

- 1 Volvulus of a portion or of all the herniated intestine
  - 2 Volvulus of the small intestine with one loop in the hernia
  - 3 Volvulus of the herniated bowel occurring immediately after its reduction
  - 4 Volvulus of the herniated bowel occurring some time after its reduction
- Miller added two more groups:
- 5 Volvulus of a distant afferent loop above a strangulated hernia
  - 6 Volvulus, generally of the large intestine, distal to a simulated strangulated hernia

**Degree of Torsion**—Symptoms of volvulus may be produced by a quarter twist (90 degrees), a half turn (180 degrees), or a complete twist (360 degrees). Very rarely the loop may rotate more than 360 degrees. (Fig 17)

**Etiology**—Volvulus or torsion of the intestine seldom occurs except in inguinal hernia, and is almost always found in subjects of middle or advanced age. It is frequently due to the continual movement of the nonadherent intestine in the sac, and may rarely be caused by the presence of benign or malignant growths. It is often aggravated by the pressure of a truss or by trauma. Acute volvulus is sometimes due to attempts at taxis. Torsion of the intestine is sometimes complicated by twisting of the omentum. The etiology has been discussed in detail by Parry, and the pathology has been covered by the paper of Tseng.

**Symptoms**—The symptoms of intestinal volvulus in strangulated hernia are usually of sudden onset and then severity is out of proportion to those ordinarily expected. Shock, prostration and collapse are usually extreme from the beginning, and there is almost always pain with tenderness referred to the hernia, which has recently become irreducible. There is also severe abdominal pain and often tenderness over the abdomen above the hernia.

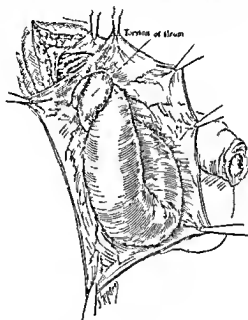


Fig. 17—Volvulus of the Intestine in a hernial sac

Owing to the similarity in the symptoms intestinal volvulus is nearly always mistaken for acute intestinal obstruction and is very seldom diagnosed before operation. The fact that the volvulus may be some distance above the sac in the abdominal cavity should put the surgeon on his guard, and, if the condition found in the sac does not account fully for the symptoms, the intestine above the constricting ring must be examined by drawing it down into the wound or by making a supplemental incision.

Whenever the symptoms of obstruction persist after an apparently successful operation for strangulated hernia, no time should be lost in performing an exploratory laparotomy to search for an intraabdominal torsion above the hernia. Unless the obstruction is found promptly and relieved, the patient will die.

**Prognosis**—The prognosis for volvulus complicating strangulated hernia is grave. The danger lies in the possibility of the volvulus being overlooked at the time of the operation for the strangulation.

**Treatment**—Immediate operation is the only treatment for volvulus complicating strangulated hernia. The twisted loop must be found, the torsion relieved, and suitable precautions taken against its recurrence. A good plan is to attach the intestine or its mesentery to the parietal peritoneum or to the omentum, with two to four sutures. If the intestine is gangrenous, resection is indicated. If the patient's condition is critical, his life may be saved by a two-stage operation, limiting the first one to fastening the necrotic loop in the wound, draining the intestine, and forming an artificial anus.

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## CHAPTER V

### PARTIAL ENTEROCELE

**Synonyms**—Richter's hernia, nipped hernia, masked hernia, lateral pinching of the intestine, Lavater's hernia, incorrectly called Littre's hernia

**Definition**—A partial enterocele is a strangulated hernia in which only a part of the circumference of the intestine is caught in the constricting ring

#### Historical

Partial enterocele was first observed by Fabricius Hildanus in 1598, and was clearly described by Lavater in 1672. Cases were reported by Littre in 1700 and 1714, Morgagni, in 1723, de Garencot, in 1743, Knirsch, in 1744, and others. The most important of the early papers was published in 1785 by Richter, from whom this hernia takes the name often applied to it. Important contributions to the subject were made by Meckel, in 1820, Riecke, in 1841, Defaut, in 1879, Treves, in 1887, de Beaumais in 1889, Vires, in 1897, who collected 96 cases from the literature, de Lage, in 1907, Riedel, in 1910, Sawyer, in 1921, Rhodes in 1929, Frankau, in 1931, de Signena, in 1940, Goffi Moreno, in 1941, Muñoz Areños, in 1941, Rodriguez Segadé, in 1942, Jens, in 1943, and Sartorius, in 1944.

**Pathologic Changes**—In partial enterocele the constricted portion of intestine becomes distended and swollen, and it may retain its deformity some time after the constriction is relieved, presenting the appearance of a diverticulum. This false diverticulum of partial enterocele gave rise to considerable confusion among the early writers. Even Littre mistook his two cases of hernia of Meckel's diverticulum for hernias of the intestinal wall. The changes that take place in the constricted intestine are due to the cutting off of its blood supply and to the distention of the intestine. The dilatation of the constricted intestine is always secondary to the onset of the strangulation (Fig 18).

Gangrene occurs earlier in partial enterocele than in ordinary strangulation. This fact is undoubtedly due to the direct pressure exerted on the intestine by the constricting ring. In ordinary enterocele the mesentery or omentum, on account of its elasticity, acts as a cushion or buffer and thus delays the onset of strangulation. In partial enterocele the convex surface of the loop, which is the free border opposite the mesentery, is the portion of the intestine that strangulates. The mesentery does not enter the hernial sac, and for this reason, Roser in 1886, denied the existence of partial strangulation of the intestine.

#### Etiology

When intestine is adherent to the sac wall a sudden increase in intra abdominal pressure may force the sac with its attached intestine through the

constricting ring. A partial enterocoele is most frequent in femoral, obturator, and inguinal hernias, in rare instances it is found in the umbilical, ventral, and sciatic varieties.

### Symptoms

The symptoms of partial enterocoele are similar to those described for strangulation of the entire intestine with the exception that in partial enterocoele constipation is not complete some fecal matter and gas can pass the constriction in nearly all cases, vomiting is usually absent, and when present it seldom becomes fecal in character.

Local signs are often absent. If a swelling can be detected in the femoral or inguinal region, a diagnosis is easy. Treves stated that the tumor is absent in 50 per cent of the cases. In the majority however, no tumor can be detected and the pain and tenderness over the strangulated hernia may be so slight as to pass unnoticed even by the patient himself.

A partial enterocoele in the femoral or inguinal region is often mistaken for an inflamed lymphatic gland especially when the condition is accompanied by tenderness, a degree or two of fever, and the typical symptoms of strangulation are lacking. Perforation into the sac may take place without serious symptoms developing.

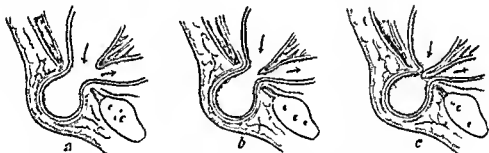


Fig 18.—Partial enterocoele. The various degrees of strangulation depend on the amount of the convex surface of the loop in the sac.

**Frequency.**—While many partial enterocoeles reduce spontaneously, the condition is present in about 5 per cent of all strangulated hernia. In a series of 100 cases of strangulation, Jens found 7 patients with partial enterocoeles. On the other hand Frankau reported a series of 1,487 cases of strangulated hernia, with 11.3 per cent partial enterocoeles.

### Diagnosis

The diagnosis of partial enterocoele is difficult because of the indefinite symptoms of intestinal obstruction and the frequent absence of a mass at the hernial opening. For this reason, the operative treatment is often unduly delayed, and the outlook is more serious than in complete strangulation because gangrene sets in more often than is realized. Nonstrangulated partial enterocoele is more frequent than statistics indicate because, during the course of an exploratory laparotomy, the surgeon frees the partial strangulation in his search for the obstruction. For this reason a diagnosis is not made unless perchance, the

surgeon happens to discover the markings of partial strangulation on the wall of the intestine Saldanha Faria and Branco Ribeiro have pointed out that partial enterocele is often mistaken for acute appendicitis and have set forth the differential diagnosis in detail The symptoms and diagnosis have also been considered at length in the excellent paper of Governale, Markiewicz, and Rotondi

### Prognosis

The prognosis for strangulated partial enterocele is grave because gangrene develops early and operation is usually undertaken late on account of the mildness of the symptoms which may delay diagnosis The mortality rate is higher than in ordinary strangulated hernia

### Treatment

The treatment for strangulated partial enterocele is the same as that for other forms of strangulated hernia Early operation is imperative A small tender, painful mass at one of the hernial openings if accompanied by only moderate gastrointestinal symptoms should be regarded with suspicion and treated by prompt operation without preliminary attempts at taxis

If the intestine is viable and no constricting furrow is seen the intestine can be returned to the abdominal cavity If there is gangrene, perforation or signs of doubtful viability, the intestine should always be resected, unless the gangrenous area is very small when it may be turned in and buried under a few Lembert sutures Large patches of gangrene should never be inverted because of the danger of postoperative stenosis When the patient's condition is grave it is often best to do two operations limiting the first one to bringing the intestine into the wound and forming a fecal fistula and closing the fistula and repairing the hernia at the second operation

Operation by the abdominal route is often to be advised as a time saver in strangulated partial enterocele in the umbilical inguinal femoral obturator, and sciatic regions For inguinal and femoral partial enterocele, immediately extend the hernia incision upward and convert the operation into a laparotomy

(For additional details on the treatment of strangulated hernia see the chapters on special hernias and the treatment of ordinary strangulated hernia)

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## CHAPTER VI

### HERNIAL TUBERCULOSIS

Hernial tuberculosis is a term applied to tuberculosis of the hernial sac its contents or both

#### Historical

Hernial tuberculosis was described by Pitha in 1845 Puech in 1878 wrote on the condition Jonnesco in 1891 discussed the pathology of hernial tuberculosis Cotte in 1906 collected the reported cases and reviewed the literature Morrison in 1914 published a valuable paper on the clinical aspects of the disease In recent years important articles have been published by Cantelmo in 1931 Martinez Vargas in 1932 Sulim in 1936 Douati in 1937 Imperati in 1938

#### Pathologic Anatomy

If viscera are in the sac the tuberculosis ordinarily involves both the sac wall and the contents In children the hernial sac is usually empty and for this reason most of the reported cases in these subjects have been tuberculosis of the sac wall In adults the sac often contains viscera and in these patients both the sac and the contents are generally involved

**The Sac**—When the sac wall is the seat of tuberculosis the entire peritoneal surface is usually affected The involvement of only a portion of the sac is comparatively rare

#### Varieties of Hernial Tuberculosis

The varieties of hernial tuberculosis are the same as those of the abdominal cavity In fact this condition is usually an extension from a focus of infection of the abdominal peritoneum as fluid in the abdominal cavity gravitates downward early in the course of the disease infecting the hernial sac

There are three varieties of hernial tuberculosis

- 1 Miliary
- 2 Ulcero caseous
- 3 Fibrous

**1 Miliary**—The miliary form is the most common The interior of the sac is studded with small miliary tubercles which may be isolated or grouped close together The sac nearly always contains more or less fluid which has the appearance of ascitic fluid in fact it often comes from the abdominal cavity and simply accumulates in the sac which occupies a dependent position

**2 Ulcero caseous**—In the ulcero caseous variety the sac wall is generally covered by a thick tough membrane and sometimes tuberculous granulations Ulceration may develop and terminate in a tuberculous abscess At this stage of the disease if viscera are in the sac they are involved by the tuberculous process

**3 Fibrous**—The fibrous type of hernial tuberculosis is rare. It almost always develops from the milky or the ulcerous variety, and generally represents the stage of healing—the so called tuberculous cicatrix. The fibrous nodules or scar tissue is often extensively adherent to the sac contents to the cord structures in inguinal hernia and to the sheath of the femoral vein in femoral hernia.

**Hernial Contents**—Any abdominal viscus that enters a hernial sac may be affected by tuberculosis. The contents most frequently involved are omentum mesentery small intestine genital organs and occasionally the large intestine.

**Intestine**—Tuberculosis of the intestine is usually of the milky variety. It may terminate in the ulcerous form and abscesses may develop between the intestinal coils the omentum and the sac wall.

**Omentum**—Hernial tuberculosis of the omentum is seldom seen in children. It is frequent in adults and appears as small diffuse tubercles scattered over the omentum. It has been compared to tapioca like granulations. There is nearly always fluid in the sac the amount depending on the severity of the infection. The omentum is usually adherent to the sac wall but rarely to the intestine. Donati in 1937 contributed one of the most complete studies on tuberculosis of the hernial sac.

**Genital Organs**—Tuberculosis of the genital organs frequently coexists with hernial tuberculosis and it is often the primary infection. Cases of tuberculosis of the fallopian tube have been reported.

**Multiple Lesions**—Multiple lesions are common in hernial tuberculosis. As a rule omentum intestine and sac wall are involved along with the testicle or with the ovary and tube. The abdominal peritoneum is involved more commonly than is generally supposed. In fact it is the usual primary site of the infection and is almost always overlooked by the operator unless he has occasion to examine the intestine lying above the hernia or finds it necessary to open the abdomen to complete the hernia operation.

### Etiology

Hernial tuberculosis is usually due to an extension downward of abdominal peritoneal tuberculosis. It is an easy matter for ascitic fluid to gravitate downward carrying tubercle bacilli into an open inguinal or femoral hernial sac. Primary hernial tuberculosis probably does occur as maintained by Jonnesco and Lejars however Morrison stated that it has never been demonstrated at postmortem examination.

An extension of an abdominal tuberculous process is the most frequent cause of hernial tuberculosis (in 70 per cent of the cases according to Cotte) and genital tuberculosis is next in frequency as a cause. As in intestinal tuberculosis the route of infection when not by direct extension is probably through the blood stream or through the lymphatics as a result of metastases.

**Frequency**—Hernial tuberculosis is much more frequent than the older statistics show. It is probably present in about 1 per cent of all cases of hernia.

**Age**—The percentage is highest in children Morrison placed it at 2 per cent It is somewhat lower in the aged, and lowest in adults and the middle aged

(IN CHILDREN)	TOTAL NUMBER OF HERNIAS	CASES OF HERNIAL TUBERCULOSIS
Broca	900	15
Coley	4571	26

In 205 cases I collected from the literature, the ages were as follows

Under 10 years	83 cases
10 20 years	37 cases
20 40 years	54 cases
Over 40 years	31 cases
	<hr/> 205

**Sex**—Hernial tuberculosis is three times more frequent in males than in females This is probably due to the fact that hernial tuberculosis attacks inguinal hernia more than any other variety, and this hernia is by far the most common in males

**Duration and Size of Hernia**—The duration of the hernia and its size have no apparent bearing on the onset of tuberculosis It has been found in hernias of all sizes

**Site of the Hernia**—Hernial tuberculosis nearly always occurs in inguinal hernia In the cases I collected from the literature, the site was as follows

Inguinal	173
Femoral	14
Umbilical	5
Double inguinal hernia	20
Double femoral hernia	1
Right inguinal and left femoral	1

**Previous Health of the Patient**—A careful history and thorough examination of the patient will almost always demonstrate active or healed tuberculous lesions in other parts of the body The lesions generally associated with hernial tuberculosis are visceral and abdominal, peritoneal, genital, including testis, epididymis, tube and ovary, pulmonary and laryngeal and bone and joint

### Symptoms

Hernial tuberculosis is conveniently divided into two varieties, painful and latent

**1 Painful or Inflammatory Type**—In painful hernial tuberculosis attention is first attracted to the hernia by a severe and continuous pain limited to the hernial tumor and referred to the abdomen only in rare instances The hernia tends to increase in size and become irreducible Sometimes hard irregular nodules can be detected in the sac contents In infants and young children there is often a congenital tuberculous hydrocele

The general symptoms of tuberculosis to be looked for are loss of weight, an evening temperature and night sweats The presence of lesions in other parts of the body tends to confirm a diagnosis, and the tuberculin test is helpful

**2 Latent Type**—The latent form of hernial tuberculosis produces no symptoms and is seldom diagnosed, except at operation

**Clinical Forms**—The most frequent clinical varieties of hernial tuberculosis according to Jaboulay and Patel, are hernio peritoneal, hernio testicular, and congenital tuberculous hydrocele

**Hernio Peritoneal**—In hernio peritoneal tuberculosis the principal symptoms—pain, distention and ascites—are referred to the abdominal peritoneum. The ascitic fluid in the sac can often be reduced into the abdominal cavity

**Hernio Testicular**—In hernio testicular tuberculosis, the process involves the testis and also the epididymis in most of the cases. In the early stage, the testis is painful and indurated. Later in the disease an abscess usually develops

**Congenital Tuberculous Hydrocele**—Congenital tuberculous hydrocele is frequent in hernial tuberculosis in infants and children. In its early stage it is often mistaken for an ordinary hydrocele

**Complications**—The complications of hernial tuberculosis are local and general. The local complications are those common to all hernias, namely irreducibility, obstruction, congestion, inflammation, strangulation, etc. The general complications are tuberculous lesions in other parts of the body, in the abdominal viscera and peritoneum, genital organs, spine, bones, joints, lungs, and meninges

### Differential Diagnosis

The diagnosis of hernial tuberculosis is often difficult, and unless the personal history is suggestive or lesions exist elsewhere, it may be impossible except at operation. The ordinary conditions to be distinguished from hernial tuberculosis are nontuberculous hernial peritonitis, epiploitis, and benign or malignant growths in the sac

### Prognosis

The outlook for patients with hernial tuberculosis is grave. The local tuberculosis in the sac often clears up after operation, but the patient usually dies from the effects of the primary lesion. In my series of 222 cases, 179 patients were treated by operation, and 9 died within a week.

The operation for hernial tuberculosis is attended with little additional risk, and the only contraindication to it is the presence of general tuberculosis, and even then operation is imperative should strangulation occur. The reason for the grave prognosis in hernial and peritoneal tuberculosis is the marked tendency of the disease to extend by metastasis to other portions of the body, complications, such as abscess formation, pulmonary tuberculosis and meningitis, often follow and are the cause of death

### Treatment

The treatment of hernial tuberculosis differs very little from that of hernias in general. Often extensive adhesions are encountered during opera-



tion, and it is sometimes necessary to leave a portion of the sac on account of inseparable adhesions between it and the cord structures, epididymis, testis, blood vessels, etc

Omentum should not be excised unless the diseased area can be completely removed, or unless resection is required to deal with adhesions. The sac should always be freely opened to obtain the benefits of air, light, and congestion or irritation of the peritoneum. Statistics show that a much higher percentage of cures follows this treatment than simple puncture and aspiration of the cystic fluid. Peritoneal tuberculosis is nearly always present also and should be dealt with through a second incision in the midline or in the lateral rectus region.

If ulceration or stricture of the intestine has developed, resection of the intestine is indicated. In addition to the operative treatment, the usual measures employed to combat tuberculosis are necessary.

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## CHAPTER VII

### HERNIA AND VOLVULUS OF THE OMENTUM

#### OMENTAL HERNIA

**Synonyms**—Omentocoele, epiplocele, epiploic hernia, hernia umbilis

**Definition**—Omental hernia is a protrusion of omentum through a normal or abnormal opening in the abdominal wall

The frequency with which omentum is found in a hernial sac increases with age. In infants and children the omentum is small, short and incompletely developed, and for this reason it does not often enter the sac. In adults, omentum is commonly in the sac and in the aged, it is nearly always present. It is usually associated with other viscera such as the small or large intestine, the bladder, genital organs, etc. Charbonnier, in 1937, reported an unusual case of strangulated omental hernia complicated with an ectopic testis. The undescended testis was at first thought to be the cause of the patient's symptoms. The author reviews the literature at length and points out the steps in differential diagnosis.

In this chapter, the omentum is considered as the sole hernial content. Omental hernias may be reducible, irreducible, inflamed, or strangulated. The variety is designated by the name of the region in which the hernia occurs. Omental hernias are common in the umbilical, ventral inguinal and femoral regions, and in the linea alba. Isolated omental hernias are usually small, seldom larger than a hen's egg and are almost always oval, elongated and cylindrical in shape, infrequently they are globular in form.

Massive omental hernias often drag on the stomach and transverse colon, producing severe gastrointestinal symptoms.

#### Symptoms and Diagnosis

The functional symptoms of omental hernia are similar to those described for intestinal hernias, but they are milder. The objective signs are as follows. On palpation the tumor is soft and yielding but not elastic. Often the irregular lobular surface can be felt. The mass reduces more slowly than intestine, without gurgling and with little or no pain. There is dullness on percussion and the impulse on coughing is less pronounced than in intestinal hernia.

**Inflammation of the Omentum**—Chronic epiploitis usually occurs in old voluminous hernias that are irreducible or controlled only with difficulty. The omentum changes into a hard irregular, nodular mass, which often is irreducible on account of the adhesions and because of the fat it accumulates after it enters the hernial sac. Adhesions to the sac wall are common, especially as a result of trauma from the wearing of a truss. Sometimes the omentum is spread out in the sac and becomes adherent by its outer surface to the sac wall, in this manner forming a second sac or epiploic sac.

At operation it is necessary to divide the omentum to expose the intestine. Inflamed hernias are due to continued trauma to contusions because of the exposed position of the swelling and to irritation from a truss etc. When infection occurs it is probably through the blood stream.

**Irreducibility**—Old omental hernias are often subject to attacks of temporary irreducibility when the hernia becomes swollen, tender and painful. Each attack is followed by additional adhesions, an increase in the size of the hernia and greater difficulty in reduction. Pipelet in 1774 called attention to the prominence of gastrointestinal symptoms in omental hernia especially when it is irreducible.

**Strangulation of Omentum**—The inflammatory stage is followed by congestion, edema and swelling of the omentum. The vein walls dilate, congestion appears, the fat loses its clear yellow color and becomes pale, opaque and pasty. Lymph exudates form on the surface of the omentum and the edema causes the separate lobules of fat to become adherent to each other.

Gangrene of the strangulated omentum is uncommon because less blood is required to maintain the viability of omentum than is necessary for intestine. On account of the lowered vitality, the fat is often the seat of inflammation that sometimes terminates in suppurative epiploitis. If the mass is examined carefully, a small gangrenous area is often found in its interior. If the neck of the sac is open, the infection undoubtedly comes from the peritoneal cavity in certain cases.

**Symptoms of Strangulation**—The symptoms of strangulated omentum are similar to those of strangulated partial enterocoele. The vomiting is not severe, sometimes it is absent and intestinal obstruction is not complete. The hernia is irreducible, somewhat painful on pressure, hard, nodular, nonfluctuating and dull on percussion. Strangulation often continues for one to two weeks and the patient does not seek medical attention until suppuration develops with pain, fever and other symptoms of hernial peritonitis.

### Prognosis

The prognosis for inflamed and strangulated epiploecles is good provided the infection remains localized in the hernial sac. The danger lies in a late diagnosis due to neglect in the beginning on account of the mild symptoms. Should the peritonitis extend to the abdominal cavity, the prognosis is grave.

### Treatment

Treatment is limited to dealing with the inflamed omentum. It should be freed from adhesions, ligated by small multiple ligatures and excised. Care must be taken not to ligate too close to the transverse colon which may be hidden behind adherent masses of fat.

The omentum should be ligated obliquely. If cut off transversely, the stump is sometimes so thick it cannot be reduced. Simple irreducibility of an omental hernia may be treated by rest, restricted diet and continuous pressure on the tumor as described for massive umbilical hernia.

Noninflamed omentum should always be returned to the abdominal cavity. The excision of omentum raises the mortality rate slightly on account of the danger of embolism, thrombosis, and postoperative epiploitis. For this reason omentum should always be treated conservatively.

### POSTOPERATIVE EPIPLOITIS

Postoperative epiploitis occurs in an omental stump that has been returned to the abdominal cavity. The condition may develop any time from a few days to a year after operation, and it is sometimes due to too much fat being left distal to the ligature. This becomes infected and a mild localized epiploitis develops, which may clear up in a few days or go on to suppuration, accompanied by severe general and local symptoms of peritonitis.

#### Symptoms

In postoperative epiploitis, the patient complains of pain in the abdomen which is aggravated by moving in bed or attempting to get up. There are often no gastrointestinal symptoms. Sometimes a mass can be felt through the anterior abdominal wall that will give a clue to diagnosis. The tumor is usually hard and irregular in shape and the localized peritonitis may make palpation painful and difficult. Rectal or vaginal examination is sometimes of value.

#### Treatment

In simple plastic epiploitis spontaneous cure is frequent, even when the tumor is large. Palliative measures consist of rest in bed and an ice bag placed over the mass.

In suppurative epiploitis the symptoms are severe and point to intraabdominal suppuration. The pressure of the infected mass may cause intestinal obstruction. When there are definite symptoms of abscess formation, the abdomen should be opened over the suspected point, the abscess incised, the pus evacuated and drainage established. The operation should be carried out as gently as possible, avoiding trauma to the tissues and the opening up of new avenues of infection in the peritoneum. Surgery in epiploitis should be employed sparingly.

### VOLVULUS OF THE OMENTUM

Torsion or twisting of the omentum occasionally occurs as a complication of hernia. This condition was described by Oberst in 1882, and Demons in 1884, who also reported cases. Lucas Championniere, in 1900, wrote at length on this subject. In 1903 Vignard and Giraudeau collected 20 cases in the literature. Corner and Pinches in 1905, published an important paper proposing a simple classification of the varieties of torsion of the omentum. Ciminata, in 1932, published a review of the literature, Covaro and Vaccarezza, in 1934, studied the pathology, Biagi, in 1936, discussed the etiology, Stolfi, in 1936, wrote on recurrent torsion of the omentum, Giordano, in 1942, reviewed the literature on volvulus of the omentum in hernia sacs.

## Etiology

Torsion of the omentum nearly always occurs in inguinal hernias. It usually complicates old hernias, both reducible and irreducible. Sometimes the only sac content is the portion of the omentum that has become adherent (Fig 19).

Possible causes of torsion are taxis, pressure from a truss, and the continual movement of nonadherent omentum in the sac.

## Varieties

There are two anatomic varieties of omental torsion, intrahernial and intraabdominal.

**1 Intrahernial Torsion**—Intrahernial torsion is infrequent. The omentum is usually adherent above at the neck of the sac and below at the fundus or near it. The twisting takes place between these two points.

**2 Intraabdominal Torsion**—Intraabdominal torsion is the variety usually seen. The omental torsion takes place within the abdominal cavity, while the intrasaccular portion is adherent to the sac wall, or is free in rare cases. There may be one or more complete twists.

In rare instances intraabdominal and intrahernial torsion are found in the same patient. The twists are usually in opposite directions. The torsion of the intraabdominal omentum takes place near the insertion of the great omentum into the colon. The changes in the omentum depend on the degree of constriction and range from a slight congestion to complete gangrene (Fig 19).

## Symptoms

From a clinical standpoint, torsion of the omentum is also divided into two varieties, the intrahernial and the intraabdominal.

**1 Intrahernial**—In the intrahernial variety the mass is painful, tense, increased in size and presents the symptoms of hernial epiploitis. The diagnosis is rarely made before operation, which is usually undertaken for suspected epiploitis.

**2 Intraabdominal**—There are two types of intraabdominal torsion of the omentum, the acute and the chronic.

*a Acute*—In the acute type the onset is sudden, with pain referred to the lower part of the abdomen, often with nausea, vomiting and partial constipation. When there are also symptoms of epiploitis in the hernial sac, the abdominal symptoms are more severe than the local ones. In acute torsion of the omentum, the mass is usually found in one of the iliac fossae and feels as though it is attached to the posterior surface of the abdominal wall. Sometimes the connection between the abdominal and hernial swelling can be established. The comparatively large tumor and the mild symptoms should make the examiner think of omental torsion. Morris stated that acute torsion of the omentum should always be suspected when an old scrotal hernia suddenly

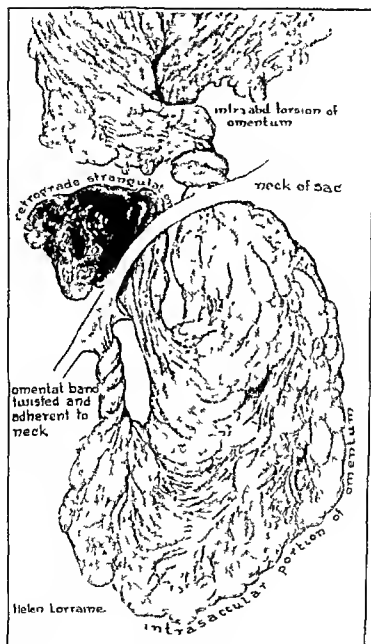


Fig 19—Retrograde strangulation of the omentum with intra-abdominal torsion

becomes irreducible and a rapidly enlarging mass appears above the inguinal (Poupart's) ligament. However, exploratory laparotomy is usually required to make a positive diagnosis.

*b Chronic*—In the chronic type the symptoms are subacute, often resembling intestinal obstruction and for this reason a diagnosis based on the symptoms is rarely possible. Consequently the connection between the intra-abdominal condition and the hernia when it is reducible is seldom suspected before the operation. (Fig 20)

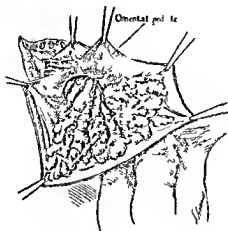


Fig 20—Volvulus of the omentum in a hernial sac

### Prognosis

The prognosis for torsion of the omentum is always serious on account of the danger of epiploitis and the possibility of gangrene developing in the twisted omentum. Intestinal hemorrhage and ulceration due to thrombi in the vessels sometimes develop as a result of omental torsion. Early operative intervention is always indicated when omental torsion is suspected.

### Treatment

The hernial sac should be opened, the omentum exposed, examined and untwisted, provided it is healthy and only slightly twisted. While a simple untwisting of the torsion is sometimes sufficient, there is always danger of the condition recurring and a safer plan is to resect the omentum, taking care not to cut too close to the intestine. When the omentum is inflamed, extensively adherent or gangrenous, it should be resected by means of multiple ligations. When there are abdominal symptoms, it is usually necessary to make a second incision, opening the abdomen to deal with the intra-abdominal torsion; this is a better plan than cutting through the hernial ring to reach the abdomen, thereby increasing the chance for a recurrence of the hernia.

When the torsion is intra-hernial, it is very important to make sure that there is no torsion higher up in the abdomen. Eiselsberg and Moreseco reported

cases of intrahernial torsion in which intraabdominal torsion also existed, and was overlooked at operation. The twisted omentum became gangrenous and caused the death of the patients.

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## CHAPTER VIII

### FATTY HERNIA

**Synonyms**—Prehernal lipoma, hernia adiposa, liparocele, steatocele

**Definition**—A fatty hernia is a mass of fat not enclosed by a peritoneal sac situated at a hernial opening

I believe that these lipomas should be called hernias only when they are accompanied by a peritoneal sac. Most so-called fatty hernias are simply isolated masses of fat unattached to a sac. True fatty hernias are most frequently encountered in the linea alba and in femoral hernias in women. They are seldom found in the umbilical or inguinal regions. Strangulation is very rare.

#### Anatomy

**Simple Fatty Hernia**—The lipomatous mass of simple fatty hernia differs very little from other subcutaneous fat. On account of its exposed position a fatty hernia is often subject to inflammatory changes resulting in the formation of a hard mass irregular in outline.

**Strangulated Fatty Hernia**—Examination of a strangulated fatty hernia after it is excised shows recent or old areas of thrombosis or hemorrhage. The mass may show a beginning inflammation or an abscess may already have formed. Gangrene due to strangulation at the neck of the lipoma or to torsion does occur but it is very rare. In strangulated fatty femoral hernia the femoral ring is nearly always the point of constriction.

#### Etiology

Fatty hernias are most often seen in young persons but strangulation is more frequent in middle life between forty and forty-five years of age. The peritoneal diverticulum that accompanies a true fatty hernia is usually rigid and inelastic consequently it cannot hold a hernia and the examining finger enters the diverticulum with difficulty.

**Strangulation**—Strangulation is most frequent in females. Of 15 cases collected by Tournier, 11 were in females and 4 in males. It was usually on the right side, this side being affected in 9 subjects, the left side in 3 subjects and in 3 the side was not designated.

**Mechanism of Strangulation**—In the beginning of strangulation there is usually only a part of the lipoma beneath the skin in the subcutaneous tissues and gradually more fat is forced through the hernial orifice by increased intra-abdominal tension or a sudden strain. When the peritoneal diverticulum attempts to pull back the intra-abdominal fat the mass is caught in the ring; it may become twisted, its blood supply obstructed or it may rarely become strangulated.

The mass is seldom larger than a pigeon's egg and with the onset of gangrene it turns reddish brown in color and has a consistency to that of molasses

### Symptoms

Simple lipomas are ordinarily painless and cause no symptoms except the slight discomfort from their presence. When a fatty hernia makes traction on a peritoneal sac, it may produce pain and reflex symptoms which necessitate operative relief. This often happens when the hernia is in the linea alba. Pain is not so uniformly present in the other varieties.

**Symptoms of Strangulation**—There is generally a history of a fatty tumor having been present for some time before symptoms of strangulation develop. It is exceptional for strangulation to occur with the first appearance of the tumor.

The pain is most marked over the lipoma. The congestion and inflammation in the tumor are responsible for the general symptoms such as nausea, vomiting, abdominal distention, partial constipation or obstruction. However, these symptoms are not always present. In some cases the symptoms do not develop for some time after the appearance of the mass; in others the symptoms are of sudden onset due to torsion or strangulation of the lipoma.

When the lipoma is strangulated it is hard, painful and irreducible and difficult to differentiate from a small strangulated enterocele or omentocele.

In nontoxic strangulation the symptoms develop slowly, usually in from four to six hours, and the typical symptoms are not well defined until about twenty-four hours later.

### Diagnosis

Diagnosis is most difficult when the tumor appears suddenly after a strain with pain, more or less nausea, vomiting, abdominal tenderness and meteorism.

**Differential Diagnosis**—Inflamed or strangulated fatty hernia must be distinguished from reducible, irreducible and strangulated hernia of the intestine, omentum or other abdominal viscera. Also from hernial peritonitis, strangulated partial enterocele, hernia of the vermiform appendix, hernia of an epiploic appendix or Meckel's diverticulum, volvulus of the omentum or intestine, strangulation of an internal hernia, intestinal obstruction, ectopic testis, epididymitis, orchitis and adenitis.

FATTY HERNIA	ORDINARY HERNIA
Appears without apparent cause or history of strain	Correlates or following a strain
Does not change in size and is irreducible	Changes in size and is usually reducible
No impulse on coughing	Impulse on coughing
Slowly increases in size	May increase rapidly in size

### Treatment

Small fatty hernias without symptoms usually do not require treatment. When there is pain or reflex symptoms, operative treatment may be demanded (see chapter on epigastric hernia). Large fatty hernias without symptoms may

require operation on account of the physical inconvenience they cause, or as a preventive measure against the subsequent development of an enterocele or omentocele

Before excising the fatty mass the operator must be sure that it consists only of adipose tissue Injury to the intestine and omentum must be guarded against, and in the femoral and inguinal regions, the bladder, appendix, ureter and a Meckel's diverticulum must be thought of When the peritoneal cavity is opened while dissecting out and excising the lipoma, the peritoneal edges should be sutured together and the hernial opening closed in the manner described in the chapters on the special hernias

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## CHAPTER IX

### INGUINAL HERNIA

**Synonyms**—Oblique inguinal hernia, indirect or external hernia, intra inguinal hernia, breach

Direct inguinal hernia, internal inguinal hernia, straight hernia, retro inguinal hernia, hernie juxtafasciculaire

**Definition**—Inguinal hernia is a protrusion of abdominal viscera through the anterior abdominal wall in the inguinal region

#### ANATOMY OF INGUINAL HERNIA

A thorough knowledge of the anatomy of the inguinal region is necessary in order to recognize the variations from the normal and to select the treatment that will give the best chance of permanent cure in each individual patient. No matter how difficult or obscure an operation may be, if the surgeon is well grounded in anatomy, he will never lose his bearings. Inguinal hernia constitutes 92 per cent of all hernias.

**Varieties of Inguinal Hernia**—Hesselbach divided inguinal hernias into the external and internal varieties, depending on their relation to the deep epigastric artery.

The external hernias are also known as "oblique" or "indirect", the latter term, which describes the oblique position taken by the hernia in its passage from the internal to the external ring is the one most commonly used.

The internal hernias which pass between the deep epigastric artery and the edge of the rectus muscle are generally known as direct hernias, because they come directly through the abdominal wall, internal to the internal abdominal ring.

**Inguinal Canal**—The inguinal canal is an oblique opening about an inch and a half (3.75 cm.) long, and is situated parallel to the inner half of the inguinal (Poupart's) ligament and a little above it. It is directed downward and inward and extends from the internal or deep abdominal ring to the external or superficial abdominal ring. It is one and a half inches (3.75 cm.) long in the male and two inches (5 cm.) long in the female, the greater length in the female being due to the wider separation of the iliac bones. In large hernias the obliquity of the canal diminishes and the two rings almost meet.

In the male, after the descent of the testis at about the sixth month, the canal contains the ilioinguinal nerve, the genital branch of the genitocrural nerve, and the spermatic cord, in the female, it contains the round ligament, the ilioinguinal nerve, and the genital branch of the genitocrural nerve. The anterior and posterior walls of the canal run obliquely downward, inward and forward, and lie in apposition except for the space occupied by the cord or the round ligament.

The inguinal canal is bounded in front by the aponeurosis of the external oblique throughout its entire length and by the lower fibers of the internal oblique at its outer third behind by the triangular ligament of the abdominal wall at its inner end and by the conjoint tendon and transversalis fascia above by the arched fibers of the internal oblique and transversalis muscles below, by the inguinal ligament as far as the posterior shelving margin which gives attachment to the transversalis fascia and at its inner end by the lacunar ligament. This lower boundary is sometimes called the posterior wall of the inguinal canal. Many anatomists describe three reinforcing fasciae—the ligament of Henle, the ligament of Hesselbach, and the iliopectineal band.

**Inguinal Canal in Infants**—In infants the obliquity of the inguinal canal is slight because it passes almost directly through the abdominal wall.

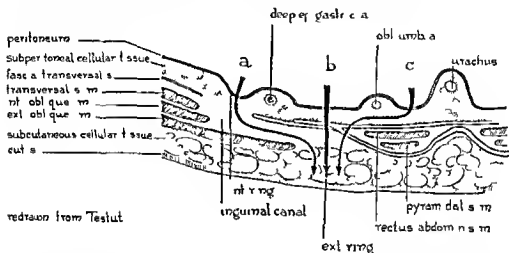


Fig 91—Cross section of abdominal wall at level of the inguinal canal. The cord has been removed.

**External Superficial or Subcutaneous Abdominal Ring**—The external ring or opening in the aponeurosis of the external oblique is located just above and to the outer side of the crest of the os pubis. This aperture is oblique in direction, triangular in shape, and usually measures about an inch (2.5 cm) from base to apex and about half an inch (1.25 cm) from side to side. It is bounded below by the crest of the os pubis, above by the curved intercolumellar fibers which pass across the upper angle of the ring to increase its strength on either side by the margins of the opening in the aponeurosis which are called the columns or pillars of the ring. The external or inferior pillar, which is formed from the part of the aponeurosis that is inserted into the pubic spine, is narrow and is curved to form a groove upon which the spermatic cord rests in the male. The internal or superior pillar is that part of the aponeurosis that lies internal to the ring and is attached to the crest and symphysis pubis.

The normal external ring will seldom admit the tip of the little finger, and it is impossible to palpate the inguinal canal or the internal ring. When the

external ring is large the cremaster muscle is well developed apparently an attempt of nature to make up for the weakness in the aponeurosis of the external oblique

**Internal or Deep Abdominal Ring**—The internal ring can be located on the external abdominal wall by a circle  $\frac{3}{4}$  of an inch (2 cm) in circumference placed about  $\frac{3}{4}$  of an inch (2 cm) above the middle of the inguinal ligament

It is an oval opening situated in the transversalis fascia midway between the anterior superior spine of the ilium and the symphysis pubis about  $\frac{1}{2}$  inch (1.25 cm) above and slightly external to the middle of the inguinal ligament. It is bounded above and externally by the arched fibers of the transversalis muscle and below and internally by the deep epigastric vessels. From the circumference of the internal ring a thin funnel shaped membrane, the fundiculiform fascia continues around the cord and testis enclosing them in a distinct pouch. This fascia constitutes one of the coverings of an indirect inguinal hernia. The internal abdominal opening is located in the extraperitoneal fatty tissue

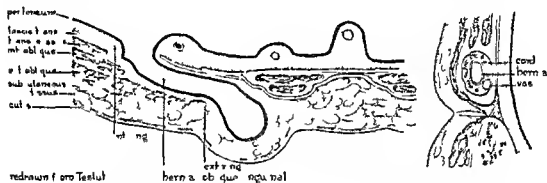


FIG. 22.—Cross section of the anatomy of indirect (oblique) inguinal hernia.

**Nerves of the Inguinal Region**—The hypogastric branch of the iliohypogastric and the inguinal branch of the ilioinguinal are the nerves encountered in the ordinary operation for inguinal hernia. The genital branch of the genitocrural lies behind the cord and accompanies it through the inguinal canal.

**Iliohypogastric Nerve**—The hypogastric branch of the iliohypogastric nerve is larger than the iliac branch and is often double and pierces the internal oblique muscle on a level with the anterior superior spine of the ilium. It then runs inward and downward on the internal oblique about  $\frac{1}{2}$  inch (1.25 cm) above and internal to the inguinal canal finally passing through the aponeurosis of the external oblique just above the external ring.

**Ilioinguinal Nerve**—The ilioinguinal nerve pierces the internal oblique below and one inch (2.5 cm) to the inner side of the anterior superior spine. It runs downward and inward over the cremaster muscle just above the inguinal ligament emerging through the external ring and supplies cutaneous branches to the scrotum or the labium majus.

**Genitocrural Nerve**—The genital branch of the genitocrural nerve accompanies the cord or the round ligament through the inguinal canal and the internal and external rings and supplies branches to the cremaster muscle. The

inclusion of this nerve in the sutures gives rise to pain along the cord, while suturing of the iliohypogastric or ilioinguinal nerves will cause a neuritis, or persistent pain in the inguinal region

**Deep Inferior Epigastric Artery**—The deep inferior epigastric artery runs upward and inward toward the umbilicus, from a point midway between the anterior superior spine of the ilium and the symphysis pubis. This artery ascends obliquely along the inner margin of the internal or deep abdominal ring where it lies between the transversalis fascia and the peritoneum, passes upward piercing the transversalis fascia, and enters the sheath of the rectus muscle by passing over the semilunar fold of Douglas

**Conjoined Tendon**—The conjoined tendon (*tendo conjunctus*) of the internal oblique and transversalis was described by Morton in 1841, and by Roustan in 1843. This tendon is usually triangular in shape with its base inserted into the crest of the pubis and the pectineal line. It is situated immediately behind the inguinal canal and the external abdominal ring, thus protecting a weak point in the abdominal wall. In direct inguinal hernia the conjoined tendon may form one of the coverings of the sac

Blake dissected twenty five normal muscular subjects and found no instance in which the conjoined tendon extended for more than  $\frac{5}{8}$  of an inch (15 cm) laterally from the insertion of the rectus muscle, in the majority it was less than  $\frac{1}{2}$  inch (125 cm) and in some it was inappreciable

**Inguinal Fossae**—Each half of the inner surface of the anterior abdominal wall in the inguinal region presents three distinct fossae, which are of clinical interest in the study of the relation of the parietal peritoneum to the different varieties of inguinal hernia

1 The internal inguinal fossa (*fossa supravesicalis*) is bounded internally by the median cord (*plica uterina*), externally, by the obliterated hypogastric artery (*plica hypogastrica*), and below, by the bladder. Direct hernia may occur through this fossa but it is very rare

2 The middle inguinal fossa (*fovea inguinalis medialis*) is bounded internally by the obliterated hypogastric artery (*plica hypogastrica*), externally, by the deep epigastric artery (*plica epigastrica*), and below by the inguinal ligament. As a rule direct inguinal hernia makes its exit through this fossa

3 The external inguinal fossa (*fovea inguinalis lateralis*) is the small depression in the peritoneum just to the outer side of the deep epigastric artery (*plica epigastrica*) which marks the internal opening of the deep or internal abdominal ring. The spermatic cord leaves the abdomen through this ring and it is the route taken by indirect or oblique inguinal hernia (Fig 23)

There are other anatomical structures which are of importance in the study of hernia but as they are fully described in any textbook on anatomy they will only be mentioned here—the inguinal ligament, the external oblique muscle and aponeurosis the internal oblique, transversalis cremaster and rectus muscles the transversalis, intercolumar and triangular fascia, the superficial layer of abdominal fascia (*fascia of Camper*), and the deep layer of superficial fascia (*fascia of Scarpa*)

**The Transversalis Fascia**—The transversalis fascia has attracted increasing interest and study in recent years because surgeons realize the necessity of

including this structure in the deep sutures. The transversalis fascia includes all of the connective tissue between the rectus abdominis muscle, inferior to the linea semicircularis, and the peritoneum, according to the research of Howell. He also observed that the fascia tends to increase in thickness in the vicinity of the spermatic cord.

**Descent of the Testicle**—Little has been added to our knowledge of the descent of the testicle since the observations published by John Hunter in 1762.

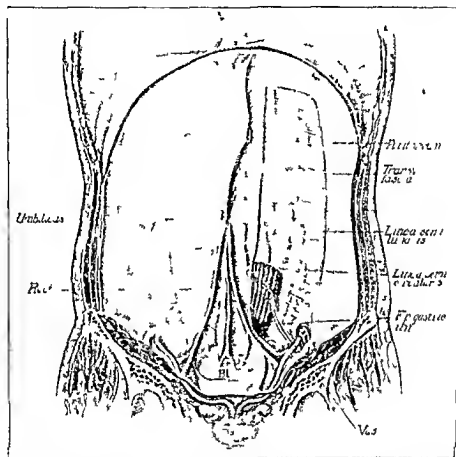


Fig. 23.—Posterior view of the anterior abdominal wall. Showing the inguinal fossae, the bladder, the deep epigastric vessels, and the deep anatomy of hernia of the lateral abdominal wall.

The retroperitoneal position of the testis is always retained, the testis and the accompanying constituents of the spermatic cord descending outside of the peritoneal pouch, which extends into the scrotum. For a time free intra-abdominal communication is maintained by the now tubular processus vaginalis; usually, however, by the time of birth, or shortly after this canal is obliterated, the isolated, lower end of the peritoneal process persisting as the pouch of the tunica vaginalis which almost surrounds the testis.

**Processus Vaginalis**—The processus vaginalis is the entire process of peritoneum that accompanies the testis and cord. It is divided into two portions: the funicular process, which invests the cord, and the tunica vaginalis testis which surrounds the testis.



The processus vaginalis or funicular process which appears at the third month of intruterine life is a canal or peritoneal diverticulum that entirely surrounds the testis and its epididymis and is continuous with the peritoneal cavity. The relation of the processus vaginalis to the testis has been a subject of considerable controversy. The processus vaginalis does not exist before the descent of the testis and the gubernaculum testis is responsible for the migration of the testis and also for the descent of the processus vaginalis which reaches the bottom of the scrotum in advance of the testis.

Whatever may be the mode of its formation the funicular process tends to become obliterated after birth. Hunter believed that the obliteration begins in the upper part of the vaginal process. Jarrold thought it started in the middle part, Férri maintained that the lower portion is the first to close. In women patency of the canal of Nuck is a cause of congenital hernia however this condition is rare because of the narrowness of the canal and the small internal opening (Figs 24-26).

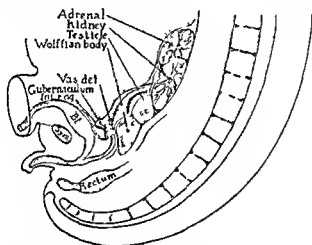


Fig. 24.—Descent of the testicle. In early fetal life the testes are located at the back part of the abdominal cavity behind the peritoneum and below the kidneys about on a level with the upper lumbar vertebrae.

**Patency of the Processus Vaginalis**—Camper in 1785 in a series of dissections in infants found the processus vaginalis open on a single side in 31.5 per cent of the subjects and open on both sides in 4.5 per cent. Ferri examined 72 infants and found an obliteration of the funicular process 34 times. Keith stated that in children three to four months old the processus vaginalis is open in 30 to 40 per cent of all cases. In infants under four months old, Sachs found obliteration in 41 per cent and permeability in 30 per cent. After the fourth month the percentage of closures was higher, obliteration being found in 69 per cent and permeability in only 4 per cent. Ramoneda examined 215 adult subjects and found abnormalities in the processus vaginalis in 15 per cent.

In 1899 Russell stated that all inguinal hernias in both adults and children were congenital in origin and were due to a persistent patent funicular process. All degrees of patency may be encountered. Longitudinal diverticula have been

observed. Transverse partitions in the processus vaginalis are not uncommon. I have found four distinct loculi in one sac with pinhole openings connecting each compartment.

**Microscopical Examination of the Sac.**—Microscopical examination of a hernial sac shows that it consists of a thin lining of endothelium lying on a thick layer of dense fibrous tissue.

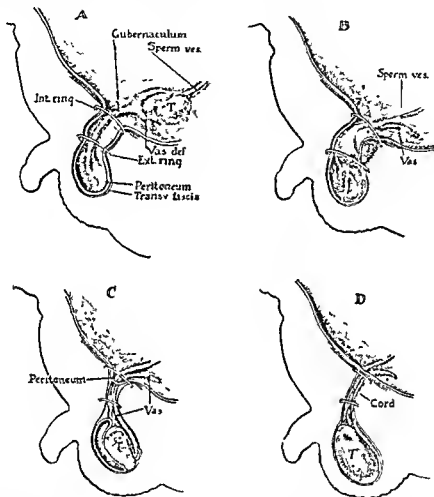


Fig 23.—Descent of the testicle

A The testicle still in the abdominal cavity Note the gubernaculum testis which precedes the testicle in its descent

B The testicle in the inguinal canal The gubernaculum becomes shorter and shorter as the testicle advances

C The testicle in the scrotum The processus vaginalis is obliterated to a point below the external ring

D The testicle in its normal position in the scrotum The processus vaginalis completely obliterated.

Hertzler remarked that one of the strongest evidences of the sac being preformed is afforded by an examination of the connective tissue at the point of union of the sac and cord. Microscopical examination will show an interlacement of fibrils running parallel to the walls of the sac and continuing over the cord, but separated entirely from other surrounding tissue. In several

hernias of less than five days' duration, microscopic examination showed that the union of the sac to the cord was made up of fully developed fibrous tissue free from cellular infiltration

**Obliteration of the Processus Vaginalis**—The obliteration of the processus vaginalis occurs at two points, first at the internal abdominal ring, and a little later at a point just above the epididymis. Between these points the processus vaginalis is an isolated tube which becomes smaller, its walls are occluded and it finally terminates in a small fibrous cord which is easily recognized during dissection or operation

If the processus vaginalis does not become obliterated, a congenital hernial sac results, which may become a hernia, either at birth or in later life

Unusual attachments of the gubernaculum below, to the tuberculum and sphincter ani, account for some forms of testicular ectopia

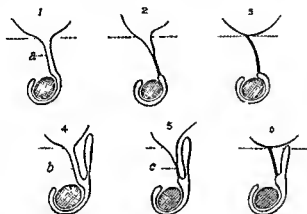


Fig 90.—The processus vaginalis

1 Completely open funicular portion. a Funicular portion of processus vaginalis. 2 Partially closed funicular portion. 3 Normal closure of processus vaginalis. 4 Hernia magna. b Completely open funicular portion. 5 Infantile hernia. c Partially closed funicular portion. 6 No hernia but potential large hydrocele (R. H. Russell)

The lower or growing end of the gubernaculum testis is composed of rapidly proliferating cells while the upper end consists of nonstriated muscle tissue attached to the globus minor and mesentery of the testis (Keith). When the lower growing end of the gubernaculum testis is diverted from its course, it may carry the testis toward the pubis outward into the groin or backward into the perineum

The attachments of the gubernaculum above to the peritoneum of the cecum, ileum, or sigmoid or to the loosely attached peritoneum lining the iliac fossa, account in part for the formation of the sac in infantile hernia

The firmness of the attachments of the gubernacula to the testes and to the dartos is shown by the fact that in huge hydroceles and elephantiasis scroti the testes will usually be found near the lower extremity or fundus of the tumor

**Torsion of the Spermatic Cord With Strangulation of the Testis**—This condition is sometimes termed torsion of the testis but torsion of the cord is what actually occurs, with strangulation of the testis as a resultant complica-

tion I observed the case of a boy five years of age with four complete twists of the cord. The cord was carefully untwisted, hot compresses were applied and the testis was saved. An anchor suture was placed so as to prevent a recurrence of the torsion. Ownby and Atkinson made an exhaustive study of the subject and found that torsion is equally divided between the right and left sides and that most of the patients are under twenty-one years of age. Torsion is twice as frequent in the undescended testis but the condition is more frequent than generally realized because surgeons hesitate to report cases when it has been necessary to excise the testis.

Early diagnosis and prompt operation are imperative if the testis is to be saved. Torsion should be suspected when there are pronounced edema of the side of the scrotum extending upward to the inguinal ring and failure to palpate the epididymis separately along with no symptoms of strangulated hernia. Bennett Jones made a painstaking review of the literature on torsion of the spermatic cord.

**Undescended Testis (Detention Retention or Arrested Testis)**—The undescended testis fails to descend into its normal position in the scrotum.

*Varieties of Undescended Testis*—The varieties of undescended testis are

- 1 The abdominal in which the testis is retained within the abdominal cavity
- 2 The inguinal in which the testis is arrested in the inguinal canal
- 3 The pubic in which the testis rests in front of the pubic bone just below the external ring
- 4 The scrotal in which the testis remains in the upper part of the scrotum

**Maldescended or Ectopic Testis**—The ectopic testis descends into an abnormal position owing to an anomalous attachment of the gubernaculum testis (see descent of the testis).

*Varieties of Maldescended or Ectopic Testis*—1 The inguinoperitoneal in which the testis passes upward and outward from the external ring in the direction of the anterior superior spine and lies on the aponeurosis of the external oblique.

2 The pubopenile in which the testis passes inward from the external ring over the pubis to the root of the penis.

3 The crural or cruroscrotal in which the testis rests in the upper part of Scarpa's triangle or more often in the fold between the scrotum and the thigh.

4 The perineal in which the testis migrates into the perineum behind the scrotum. Described by Goyrand in 1834.

5 The transposed or crossed testis in which the testis migrates intraperitoneally to the opposite side and from there passes into the inguinal canal and scrotum. Campbell reported the cases of 3 patients with perineal testis. He operated on two of them and in both placed the testis in the scrotum.

**Classification According to Etiology**—In an etiologic standpoint inguinal hernias are divided into two groups the congenital (intrafunicular) and the acquired (extrafunicular).

1 *Congenital inguinal hernia* is always of the indirect variety and the sac is found intimately adherent to the vas deferens and to other cord structures

2 *Acquired inguinal hernias* comprise all direct hernias traumatic hernias through the external inguinal fossa and those that escape through a rent in the transversalis fascia In acquired hernia the sac is not adherent to the vas deferens or to other cord structures and it may be some distance away

**The Internal Inguinal Ring**—The internal inguinal ring is mobile and stands on active guard at the entrance to the inguinal canal Contraction of the transversalis muscle tightens the internal ring When the muscle is deficient there is a lack of the usual shutter action Lytle believes that the most frequent abnormalities of the internal inguinal ring are a dilated ring poor mobility of the ring and weakness of the ring

**Mechanism of Hernia**—The obliquity of the inguinal canal is a natural obstacle to hernia because an increase in intraabdominal tension forces the inguinal walls more firmly together When a patient strains the conjoint tendon and transversalis contract vigorously and if a finger is inserted in the inguinal canal it is firmly gripped between the conjoint tendon and the inguinal ligament Keith stated that intraabdominal pressure is raised to 100 mm of mercury by straining or lifting True congenital hernias (hernias into a preformed sac) usually follow a sudden increase in intraabdominal tension which is sufficient to overcome the resistance offered by the valve like action of the inguinal canal

In addition there are often predisposing causes such as a patent processus vaginalis a depression in the infundibulum fascia a weak point in the abdominal wall congenital or acquired weakness of the abdominal muscles emphysema long continued increased intraabdominal tension prostatic disease or urethral stricture

The importance of malformation of the pillars of the external ring as a predisposing factor is generally unappreciated Marked phimosis may possibly have an influence in some cases Flongation of the mesentery is no longer believed to be a predisposing cause of hernia the lengthening of the mesentery is required as the serotal hernia is formed In the cadaver with the inguinal canal opened intestine cannot be drawn into the scrotum on account of the shortness of the mesentery

**Formation of Indirect Inguinal Hernia**—It is generally believed that all indirect inguinal hernias are due to a preformed sac which consists of an unobliterated portion of the processus vaginalis Given an exciting cause that increases intraabdominal tension a knuckle of small intestine or a piece of omentum is forced through the internal ring into a preformed sac The sac lies in the inguinal canal above the cord and descends in front of it While a slight bulge over the internal ring may remain unchanged in size for years once the sac has passed the ring it has overcome the point of greatest resistance and its progress down the inguinal canal is rapid If the pillars of the external ring are well developed and the opening is only large enough to allow the passage of the cord the hernia may be temporarily checked in its descent at this point

Beyond the external ring, the coverings of the sac exert only very little resistance, and the hernia quickly descends to a position opposite the upper level of the testis, where the firm connections between the coverings of the cord and the tunica vaginalis may check its progress. If it overcomes the resistance here, it usually goes to the bottom of the scrotum and is known as a scrotal hernia. (Fig. 27.)

In complete hernias, descent is probably aided by the weight of the hernial contents and by the mesentery which elongates and ceases to lend its support to the intestines. In females the hernia follows the round ligament through the inguinal canal into the labium majus.

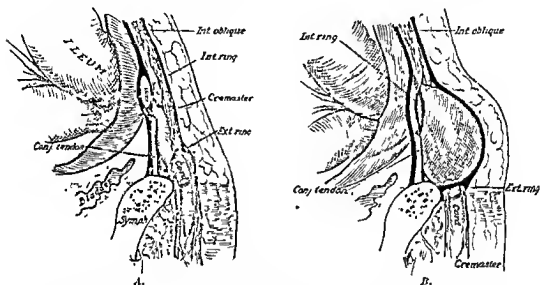


Fig. 27.—Formation of indirect inguinal hernia.

A, A slight bulge at the internal abdominal ring. Note the obliquity of the inguinal canal which is an actual obstacle to the development of hernia.  
B, The dilatation of the inguinal canal completed. The hernia has reached the external ring.

**Varieties of Indirect Inguinal Hernias.**—The indirect inguinal hernias leave the abdomen through the internal ring, and are of three varieties, according to the degree of descent of the sac, namely, incomplete, complete, and scrotal.

1. In the incomplete variety (bubonocoele), the sac remains in the inguinal canal.
2. In the complete variety, the hernial sac emerges from the inguinal canal at the external ring.
3. In the scrotal variety, the hernia passes down into the scrotum.

Indirect inguinal hernias are also classified into the congenital, infantile, and funicular varieties, according to the degree of patency of the processus vaginalis. Numerous anomalies in the closure of the processus vaginalis have been observed from time to time, and have given rise to elaborate descriptions in the literature of unimportant subdivisions of these three varieties.

**1. Congenital Hernia.**—In congenital inguinal hernia the vaginal process is entirely open and continuous with the abdominal cavity, and the sac envelops both the hernial contents and the testis, which lie in contact with each

other Congenital hernia is rarely present at birth but is first observed in infancy, as a rule, following a strain which forces the intestine down into the sac (Fig 28)

**2 Infantile or Encysted Hernia (Hernia With a Double Sac)**—Infantile and encysted hernia are identical This hernia was first observed by Mery and Petit in 1701, by LeCrot in 1753 and in 1764 it was fully described by Hey, who called it infantile hernia probably because the case he observed was in an infant Later, Cooper found this hernia associated with a hydrocele and named it encysted hernia The only difference in Hey's and Cooper's cases was that in Hey's case the tunica into which the hernia protruded was empty, and in Cooper's case the tunica vaginalis contained a hydrocele

In infantile or encysted hernia the processus vaginalis is closed only at the internal ring Intraabdominal pressure aided by the descent of the testis causes a sac or pouch of peritoneum to descend in front of the cord or vaginal process, or what usually happens is an invagination of the hernial sac into the sac of a hydrocele These hernias have three layers of serous membrane between the sac contents and the skin the peritoneal sac and two layers of tunica vaginalis These are connected with each other at the neck of the sac (Figs 29 and 30)

Russell remarked that many so called infantile hernias are simply the result of an accident of taxis A rent in the peritoneum near the neck of the sac allows the intestine to come down beside the sac

**3 Funicular Hernia**—In funicular hernia the processus vaginalis closes only at its lower end just above the epididymis while the peritoneal diverticulum or funicular process is continuous with the peritoneal cavity, and is open from the deep abdominal ring to the epididymis The hernial contents are separated from the testis by the septum formed at the point of obliteration, the normal tunica vaginalis (Fig 31)

**Canal of Nuck**—A peritoneal diverticulum in the inguinal canal in women which was first described by Nuck in 1672 and corresponds to the processus vaginalis testis in man is the cause of indirect inguinal hernia in females The canal of Nuck is normally obliterated about the seventh month of intrauterine life earlier than in the case with the processus vaginalis testis The patency of this process was noted in 18 per cent of the subjects examined by Fire in 24 per cent of those examined by Zuckerkandl, and in 25 per cent of those examined by Sachs

**Gubernaculum in the Female**—In the female also there is a gubernaculum that influences the position of the ovary to a certain extent The remains of the gubernaculum lying between the attachment of the cord to the uterus and its termination in the labium majus forms the round ligament of the uterus

**Indirect Inguinal Hernia in the Female**—The inguinal canal in the female is longer and narrower than that in the male It gives passage to the round ligament and its vessels to the genital branch of the genitocrural nerve and sometimes to a peritoneal diverticulum (the canal of Nuck) After leaving the external ring the hernia passes into the upper part of the labium majus If it remains incomplete it is a bubonoecele or pubic hernia and its oval or globular shape resembles a direct inguinal hernia in the male Incomplete

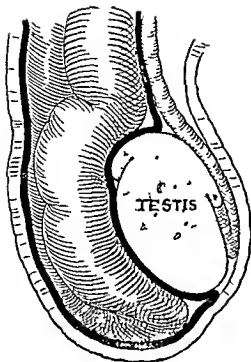


Fig 28

Fig 28—Congenital hernia. The vaginal process is entirely open and continuous with the abdominal cavity. The sac envelops both the hernial contents and the testis, which lie in contact with each other.

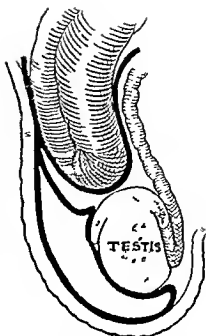


Fig 29

Fig 29—Infantile hernia. The processus vaginalis is closed only at the upper end.

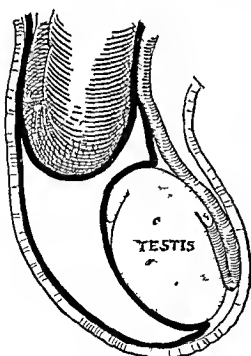


Fig 30

Fig 30—Infantile hernia (encysted type). This condition is usually caused by the invagination of a hernial sac into the sac of a hydrocele.

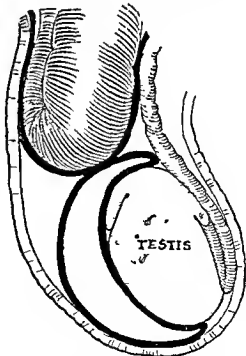


Fig 31

Fig 31—Funicular hernia. The processus vaginalis is closed only at its lower end. The hernial contents are separated from the testis by the obliterated portion of the processus vaginalis, the normal tunica vaginalis.



hernia is the form commonly found in the female, and it does not become labial, as frequently an indirect inguinal hernia in the male becomes scrotal.

**Coverings of Indirect Inguinal Hernia**—The coverings of indirect inguinal hernia are of interest to the anatomist, but of little value to the surgeon, save in exceptional cases in which they may serve as landmarks. They are usually so matted together in inflamed or old hernias that the layers can not be identified. A complete indirect inguinal hernia has the following coverings: (1) the extraperitoneal connective tissue, (2) the infundibuliform fascia (transversalis), (3) the cremaster muscle, (4) the intercolumnar fascia (from external oblique aponeurosis), (5) the superficial fascia—the dartos in scrotal hernia, and (6) the skin.

**Deep Inferior Epigastric Artery**—The deep inferior epigastric artery is an important landmark in the anatomy of inguinal hernia, and it may be outlined on the abdomen by drawing a line from a point midway between the anterior superior spine and the symphysis, to a point on the outer edge of the rectus abdominis muscle midway between the umbilicus and the symphysis pubis. Hernias lying external to the epigastric artery are known as indirect, while those internal to the vessel are direct.

**Hesselbach's Triangle**—Hesselbach's triangle is bounded on the outer side by the deep inferior epigastric artery, on the inner side by the rectus muscle, and below by the inguinal ligament. Chandler has published an important study of the inguinal (Hesselbach) triangle.

**Direct or Internal Inguinal Hernia (Hesselbach's Hernia)**—Direct inguinal hernia is so named because it takes the most direct route through the abdominal wall, passing through only the lower fifth of the inguinal canal. It is sometimes called internal inguinal hernia because of its position internal to the deep inferior epigastric artery. It is also called straight hernia.

Direct hernias usually break through into the inguinal canal because the resistance is less in that direction than it is inward toward the rectus muscle. These hernias are never congenital and they have no preexisting path. They are of slow development and ordinarily occur in adults. They are characterized by a small sac with a relatively large opening, and because of the shortness of the neck of the sac, they are globular in shape. Direct hernias generally remain bubonocoeles, and on reduction go directly backward into the abdomen. The abdominal opening is easily felt, as it has the outer edge of the rectus muscle to the inner side and the crest of the pubis below. Direct hernias rarely descend into the scrotum. After all, they are in reality ventral hernias and all they have in common with indirect inguinal hernias is the external inguinal ring. (Fig. 32.)

The abdominal wall over the middle fossa is strengthened by the rectus muscle, which is attached to the pubic crest, and also by the triangular (Colles') ligament, which consists of the inner or deeper fibers of the inguinal ligament that turn upward and inward from the crest of the pubes in front of the insertion of the conjoint tendon. This ligament passes behind the internal pillar of the external ring and is inserted into the anterior sheath of the rectus and into the linea alba, it protects the inner and posterior wall of the canal in the

angle between the pubes and the rectus muscle, and far enough outward to correspond to the inner third of the external ring in males, and to the inner half of the external ring in females (Malgaigne)

**The Weak Spot**—The weak spot of the middle fossa is the usual point of exit of direct hernia. It is directly behind the lower fifth of the inguinal canal and the upper edge of the external ring between the outer edge of the rectus muscle and the deep epigastric artery, at a point where the abdominal wall contains no muscular layer, being weakened anteriorly by the gap in the external oblique aponeurosis at the external ring. The thinnest point, however, is at the upper and outer angle of the external ring where the posterior wall of the canal is not reinforced by the conjoint tendon or the triangular (Colles') ligament. Here there is little or no conjoint tendon and the cremaster is often absent.

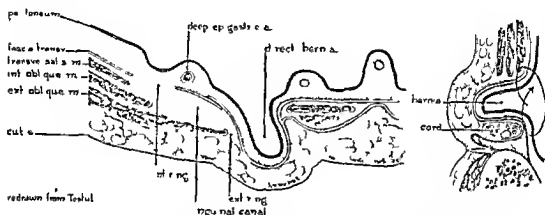


Fig. 32.—Cross section of the anatomy of direct inguinal hernia.

The weak spot is bounded internally by the aponeurotic fibers of the transversalis muscle which run from the upper surface of the pubis to the rectus, and externally by similar fibers from the transversalis muscle which encircle the inner border of the internal ring and fuse with the inner surface of the inguinal ligament. Spalteholz stated that when these aponeurotic fibers are broad the weak spot is narrow, and when they are poorly developed the weak spot is wide. This spot is weaker than any place in the external inguinal fossa.

**Points of Exit of Direct Hernia**—A direct inguinal hernia may escape through two routes:

- 1 Through the middle fossa, between the plica epigastrica and the plica hypogastrica around the outer edge of the conjoint tendon, where it enters the canal below the internal ring. This variety of direct hernia has the same coverings as an indirect hernia, except that in direct hernia the general transversalis fascia replaces the infundibuliform fascia of the oblique variety (Fig. 33).

- 2 Through the outer part of the internal or supravesical fossa, which lies between the plica urachi and the plica hypogastrica, the outer and deepest part of the internal fossa corresponding to the external ring. The hernia passes

around the edge of the conjoint tendon and the triangular ligament, or, if these structures are thin and poorly developed it may carry them with it, so that its coverings would be (a) extraperitoneal connective tissue (b) transversalis fascia, (c) conjoint tendon (d) triangular (Colles) ligament, (e) intercolumnar fascia (f) superficial fascia, and (g) skin.

**Relation of Spermatic Cord to the Sac**—The spermatic cord does not accompany a direct hernia but usually lies some distance to the outer side of the

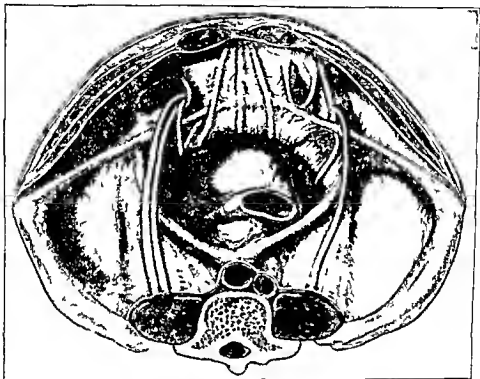


Fig. 23.—The internal openings of direct and indirect inguinal hernia and femoral hernia. (Re-drawn from Wullstein.)

**Double Direct Hernias**—Double direct hernias on the same side have been seen but they are very rare. Corlette observed at operation two direct inguinal hernias on the same side in a man aged fifty six years. Goldowsky reported a rare case of direct hernia in a man. The opening was a narrow defect in the transversalis fascia at the inner and lowermost corner of Hesselbach's triangle. The aperture admitted one finger and the size was 4 inches (10 cm.) long.

**Relation of Direct Hernia to the Linea Semilunaris**—Direct hernia is a hernia in the linea semilunaris, and it should be classified as ventral hernia. It was first described as ventroinguinal hernia by Monro. Scarpa adopted a similar classification which has since been advocated by Macready, Deekes and others.

**Direct Inguinal Hernia in Women**—Direct inguinal hernia is less common in women than in men because in women the shape and formation of the in-

ingual canal are different the external ring is smaller and the aponeurosis of the external oblique covering the inguinal canal is stronger. The etiologic factors found in men are not present in women and in the latter the wider pelvis is a safeguard against the occurrence of direct hernia as pointed out by Greene and Neuhoﬀ.

Donati dissected 31 female and 21 male endavers. He found that in females the internal oblique muscle was better developed in front of the canal than in males and the arching fibers were often reenforced by cross fibers which were absent in the males. The linear interstices in the external oblique aponeurosis were larger in the males than in the females.

**Congenital Inguinal Hernia With Anomaly of the Testis**—The commonest types of congenital inguinal hernia with anomaly of the testis are as follows:

1 *Hernia With Ectopia of the Testis*—The testis may be retained in the iliac fossa in the inguinal canal or in front of the latter or after leaving the canal it may pass downward toward the genito-crural fold or toward the perineum. When the testis has not descended the intestine enters the canal encircles the misplaced testis and passes through the external inguinal ring into the scrotum. There is frequently a constriction at the external ring which divides the hernia into two portions one being in the inguinal canal and one in the scrotum. This is the hourglass or wallet hernia (*hernie en bissac*)—a rare variety.

2 *Hernia With Inversion of the Testis*—The testis and cord are found behind the hernia instead of in front of it.

3 *Hernia With Incomplete Descent of Testis*—When the testis is just outside the external ring and a hernia occurs it descends in front of the testis. The external ring is enlarged and the testis passes out and in. This is the hernia usually found in the newly born and infants.

**Undescended or Maldescended Testis in Interparietal Hernia**—Undescended or maldescended testis is generally associated with interparietal hernia in the male. The testis is often retained in the inguinal canal where it is only slightly movable and causes a bulging in the sac. When it descends beyond the external ring it is usually arrested at a point just below this opening. In fact it is found in the upper part of the scrotum only in those cases in which the outer loculus projects toward the scrotum. The ectopic testis is often in the abdominal cavity.

**Inguinal Hernia and Cyst of the Cord**—The processus vaginalis may become obliterated at any point below the internal ring and remain open farther down. These persistent enclosed portions are liable to become the sites of cysts which develop when an accumulation of serous fluid has formed.

**Cysts Connected With Hernial Sacs**—Cysts connected with hernial sacs are due to anomalies in the obliteration of the processus vaginalis. A great variety of these cysts have been described and they are sometimes incorrectly called *hydroceles of the cord*. I agree with Murray and Lockwood that they are due to a duplication of the processus vaginalis in which a second sac is drawn by additional fibers of the gubernaculum testis.

**Hydrocele Associated With Hernia**—Hydrocele is due to an incomplete obliteration of the processus vaginalis and is often associated with hernia. The hydrocele may assume a variety of forms and it may be situated in any position in relation to the hernia—above it, in front of or behind it, on one or both sides of it, or the hydrocele may entirely surround the hernia.

A hydrocele may have one or several loculi in the scrotum and in the inguinal canal. Sometimes a portion of the sac, large enough to hold all the fluid in the loculi of the scrotal portion is in the abdominal cavity. I operated on a patient in whom the abdominal loculus held the contents of three scrotal loculi amounting to two quarts (2 liters) of fluid.

**Lipomas in the Inguinal Canal**—Lipomas are frequently found in the inguinal canal along the cord. Their lower portion is usually attached to the sac, and their upper portion is continuous with the preperitoneal fat at the internal ring (see chapter on fatty hernia).

**The Sac**—The portion of the sac that lies in the internal ring is known as the *mouth* of the sac, on account of the constriction of the ring. The sac at this point lies in folds. The *neck* of the sac is the portion in the inguinal canal, it lies smoothly, held by the confines of the walls of the canal. The *fundus* or *body* of the sac lies beyond the external ring. It is usually oval or oblong in shape and its walls may be considerably thickened due to the long continued intra-abdominal pressure and to the sagging weight of the contents and to the external irritation of clothes, trauma and truss. The peritoneal sac is usually freely movable. Bill found that when operating for double hernia torsion of one sac markedly diminished the size of the hernia on the opposite side.

**Diverticular Hernial Sacs**—One or more diverticuli occasionally are found with hernial sacs. The communicating type of sac is twice as frequent as the noncommunicating variety. Usually one diverticulum is empty and they are seldom of the same size. Burton and Blotner have written interestingly on this subject.

**Contents of the Sac in Inguinal Hernia**—In adults a majority of inguinal hernias contain omentum, sometimes small intestine, rarely large intestine or other abdominal viscera. Every abdominal viscera has been found in the sac of inguinal hernia.

**1 Omentum and Small Intestine**—The omentum descends into the sac first. As the hernia enlarges the small intestine descends and lies behind the omentum—their relative position being the same as in the abdominal cavity. As pointed out by Dionis, omental hernias are more frequent on the right side because the omentum extends lower on this side. Berecann reported an unusual case of sarcoma of the omentum incarcerated at the right internal inguinal ring and first diagnosed as a case of appendicitis.

Of the small intestine the ileum is found much more frequently than the jejunum.

**2 Large Intestine**—The large intestine is alone in the sac only in rare instances. As a rule it follows the omentum and the small intestine in their descent into the sac. Lust reported a case in which x-ray examination showed

the esophagus extending to the level of the iliac crests, and two thirds of the stomach lying in a left inguinal hernial sac

In old, massive, irreducible hernias the entire small intestine and large intestine may be found in the sac. In 800 cases of hernia of the large intestine that I collected from the literature, the different portions of the large intestine entered the sac in the following order of frequency: cecum, sigmoid, ascending colon, descending colon, and transverse colon.

**3 Stomach**—Inguinal hernia of the stomach is very rare. In nearly all of the cases I have collected from the literature, only a portion of the stomach was found in the sac. Joige, Feldman, and Iturrioz reported a case of inguinal hernia of the stomach and reviewed 22 cases found in the literature.

**4 Kidney and Ureter**—Inguinal hernia of the kidney and ureter are very rare. In four cases reported in the literature, the hernia was unilateral, and the right kidney was the one herniated.

**5 Ovary, Tube, and Uterus**—The ovary and tube are sometimes found in inguinal hernia. As a rule they are congenital in origin.

**6 Bladder**—A portion of the bladder is found in about 1 per cent of all inguinal hernias. The prostate is very rarely found in inguinal hernial sac.

**7 Other Hernial Contents**—Other hernial contents sometimes found in inguinal hernial sacs are detached and hardened appendices epiploicæ and pieces of omentum, and foreign bodies such as pins, tacks, nails, and pieces of metal, wood or bone.

**Disease of the Hernial Contents**—Among the lesions sometimes found in the hernial contents may be mentioned lipomas adherent to the cord or sac, epiploitis, suppuration of the hernial contents, drainage of appendiceal or other abscesses into the hernial sac, tuberculosis of the sac or contents, cysts and benign and malignant growths. Finocchiaro reviewed the literature on hernial sac inflammation and its complications.

**Intrasaccular Adhesions**—Omental adhesions are very rare in children, but are almost always found in adult hernias.

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## CHAPTER X

### ETIOLOGY OF INGUINAL HERNIA

Before the adoption of the *sacculus* theory, indirect inguinal hernias were divided into the congenital and acquired varieties. The congenital form was believed to be limited to infants and children, and the acquired form to adults. It was thought that a peritoneal sac was forced through a weak point in the abdominal wall following a strain or trauma. The present opinion is that except for the rare cases of true traumatic hernia, all indirect inguinal hernias are congenital in origin, regardless of the age of the subject when the hernia first appears.

Congenital hernias are due to the persistence of a patent processus vaginalis, and a sudden strain or traumatically forces the abdominal viscera into a congenital preformed sac. There are two distinct varieties of congenital hernial sacs:

- 1 The complete sac, which is continuous with the tunica vaginalis. This is the infrequent variety, occurring in only 10 per cent of infants and children.

- 2 The incomplete sac, which is entirely separate from the tunica vaginalis. This is the more common variety, both in children and in adults.

**Descent of the Testis**—The descent of the testis, which is fully described in the chapter on anatomy, is an important factor in the cause of inguinal hernia, because an undescended testis is nearly always accompanied by an actual or a potential hernial sac. I recently saw a boy, five years old, with a hernia and undescended testis of the right side, whose family history was of interest in that both his father and his paternal grandfather had had an undescended testis and hernia that persisted into adult life.

**Processus Vaginalis**—The processus vaginalis descends ahead of the testis, and when obliteration fails to take place at birth, this canal becomes a potential hernial sac. Robins believes that the shutter action of the internal oblique muscle, as described by Sir Arthur Keith, not only keeps the inguinal canal closed, but undoubtedly assists in the obliteration of the processus vaginalis testis. When the lower portion of the muscle is weak or deficient, there is a lack of the muscle shutter action and as a result there is more likely to be a congenital indirect inguinal hernia that persists into adult life. The canal of Nuck in the female is analogous to the processus vaginalis testis in the male. When the processus vaginalis closes normally, it is converted into a white fibrous cord which is easily recognizable during dissection or operation.

It is generally agreed that all indirect inguinal hernias are of congenital origin. When obliteration is incomplete, fibrous bands may form anywhere in the funicular process. I have seen one of these constrictions that was responsible for strangulation, in the lower part of the scrotum.



**Experimental Hernia**—Burrows and others have produced serotal hernias in mice and various laboratory animals by administering estrin and similar hormones, such as antuitrin S. The latter is a valuable adjunct in the treatment of undescended testis. Burrows found that 47 out of 78 male mice developed hernia after receiving estrogenic preparations. Incidence of hernia was most marked when the testis was in the scrotum although a fully developed intra-abdominal testis would usually develop a hernia with estrogen. There was no hernia development if the testis was absent. Small hernias usually disappeared when estrogen was stopped.

**Potential Hernia**—The presence of empty congenital sacs in adults is more common than is generally supposed. Many people carry these potential hernial sacs throughout life without evidence of hernia.

In the postmortem examination of one hundred subjects that presented no evidence of hernia during life, Murray found sacs in 21. In several of these there was more than one sac. In another series of 200 examinations, Raw and Murray found 65 potential diverticula, and of these 52 were femoral, 13 inguinal and 3 umbilical. Murray believed that when a patent funicular process exists, the occurrence of a hernia depends on the size of the opening at the internal abdominal ring and the strength of the muscles that protect this orifice. He also stated that when the processus vaginalis has been completely obliterated it is impossible for an indirect inguinal hernia to occur.

Hernias are most likely to come down into preformed sacs following the activities of youth, the laborious occupations of adult life and the strain of repeated pregnancies. Inactivation due to disease or old age may also be a factor by removing the fatty plugs that have kept the patent funicular process temporarily closed.

It is not unusual to see an indirect inguinal hernia develop on the sound side after one on the opposite side has been reduced and retained by a truss or cured by operation. This second hernia is probably due to an increase in intraabdominal tension. I often advocate a bilateral operation or the injection treatment for inguinal hernia especially in young adults. In 50 operations for unilateral hernia I found a potential sac on the opposite side in 22 cases. I have used the combined operation a number of times and occasionally have been surprised to find a larger sac on the sound side than on the affected side. I believe it is always advisable to operate or inject on the sound side when there is an enlarged ring or an exaggerated impulse.

**Anatomic Causes of Indirect Inguinal Hernia**—The anatomic factors that favor the development of indirect inguinal hernia may be summarized as follows: (a) the descent of the testis which carries with it a process of peritoneum transversalis fascia (infundibuliform fascia), and cremaster muscle; (b) the weak spot at the internal ring caused by the pouching of the peritoneum; (c) the location of the internal ring which makes it unable to resist sudden increase in intraabdominal pressure caused by straining, coughing, whooping cough, pregnancy, tight lacing, obesity, ascites and tumors; (d) the hernia cannot break through outside the internal ring because of the well developed iliac and

transversalis fascia, (e) the fact that there is usually a weak point near the inner side of the internal ring that is unprotected by muscle or tendon, (f) the existence of an unobliterated processus vaginalis or a preformed sac (Fig 34)

**Hernia Following Hydrocele Operation**—When a large tense hydrocele extends into the inguinal canal, it weakens the internal ring and destroys the obliquity of the inguinal canal. Unless a herniorrhaphy is done at the time of the hydrocele operation, a hernia usually develops in a few weeks or months

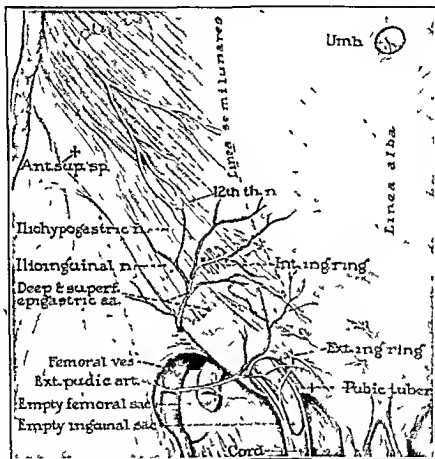


Fig 34—Small congenital inguinal and femoral hernias. Showing the relation of the femoral and inguinal nerves vessels fascia and hernias

**Patent Processus Vaginalis and Undescended Testis**—Undescended testis is nearly always associated with a patent processus vaginalis—a potential hernia sac

**Military Training and Indirect Inguinal Hernia**—During the war many recruits who were called from sedentary occupations to military service developed hernias under intensive training. It is an interesting point, and one that lends weight to the sacular theory, that most of these hernias appeared during the early period of training. If the muscles could withstand the strenuous unaccustomed exercise for the first few weeks, the added resistance that comes from such training made the later appearance of hernia infrequent.

**Frequency of Hernia in Selective Service Registrants and Defense Workers**—Rowntree states that in 13 000 000 physical examinations of selective service registrants during World War II, the U S Army Medical service examines found 229 000 hernias, or 5.7 per cent. He remarks that at first in inguinal hernia patients were placed in a deferred classification but when the hernia 'pool' passed 200,000 the hernia patients were accepted and either operated on or given deferred classification. Rowntree points out that the Navy accepted hernia patients from the start of the war and insisted on an operation; however, the principal objection to the repair of hernias under compulsion was the psychic trauma, the result of painful scars and functional disability.

Cover and Widder stated that in 14 175 examinations of defense workers at a Naval supply depot right inguinal hernias were more frequent than left hernias. Also potential hernias were most frequent on the right side. They found that 3.71 per cent of white male workers between eighteen and fifty years of age in a Naval supply depot had inguinal hernia. In men over fifty years old the rate rose to 9.2 per cent.

Nilsson in 7 967 examinations of railroad employees observed 760 hernias. He concluded that 93 out of every 1,000 men had hernia at one time.

**Frequency of Inguinal, Femoral, and Umbilical Hernia**—The inguinal variety constitutes 92 per cent of all hernias, femoral 2.5 per cent, umbilical 2 per cent, incisional ventral 1.5 per cent, epigastric 1.0 per cent and all other hernias 1 per cent. Inguinal hernia comprises 96 per cent of all hernias found in adolescent and adult men and 50 per cent of the hernias that occur in adolescent and adult women.

Femoral hernia are nearly always found in women, 97 per cent in females and only about 3 per cent in males; however it is only slightly more frequent in women who have not borne children than in men. It is rarely found in either sex under twenty years of age. Umbilical hernias usually occur in women, 75 per cent compared to 25 per cent in men.

The statistics vary considerably from different clinics depending on whether most of the patients examined were men, women or children. Femoral hernia is comparatively rare in men, frequent in women and seldom seen in young boys and girls.

**Frequency of the Different Varieties of Inguinal Hernia**—Indirect inguinal hernias constitute nearly 84 per cent of all inguinal hernias in men.

McLaughlin and Brown observed a group of uncomplicated inguinal hernias in young male Naval recruits. The distribution of the different types of inguinal hernia is shown.

TYPE	NUMBER OF CASES	PER CENT
Inguinal hernia indirect	956	91.8
Inguinal hernia direct	81	8.2
Inguinal hernia bilateral	108	10.0
Inguinal hernia right	50	58.0
Inguinal hernia left	403	42.0
Inguinal hernia complete	301	28.6
Inguinal hernia incomplete	16	71.4
Inguinal hernia recurrent	20	1.8

The direct variety were usually bilateral. Direct hernias were most frequent in recruits twenty five to thirty five years of age, especially those of short stature and with a tendency to overweight.

**Emaciation and Starvation as Cause of Hernia**—Emaciation, due to disease or old age, may also be a factor, by removing the fatty plugs that have kept a patent funicular process temporarily closed. Owing to a lack of food during World War I, there was an increase of 40 per cent of hernia in Germany alone. In World War II, emaciation of prisoners of war in France accounted for a sharp increase of hernias. Giraud stated that the average incidence of hernia was 59 per cent in repatriated prisoners compared to 41 per cent in nonprisoner soldiers. The average loss of weight was 10 kilograms, with some prisoners losing as much as 25 to 35 kilograms. Braine and Rudler found that in the same period of "restrictions" in France, hernias increased greatly in frequency, especially the femoral type. All forms of strangulation increased from 3.3 per cent in 1938 to 8.7 per cent in 1941. One out of every four hernias operated on was strangulated. The condition became worse as the war progressed.

**The Length of the Inguinal Ligament**—The relationship of the inguinal ligament to the development of indirect and direct hernia, as well as to their recurrence after operation, has attracted considerable attention from surgeons. Harris and White stated that when the inguinal ligament measures 11 to 15 cm, the hernia is always indirect, while a direct hernia is always present when the ligament measures 15 to 19 cm in length. When the length of the ligament is less than 11 cm, there is little tendency to the development of hernia. For the same reason, there is less danger of recurrence when the ligament is short. Znachkovsky in 1935, Harris and White in 1937, Rebusello in 1938, and Hillenbrand in 1940 published papers on the predisposition to hernia in patients with a long inguinal ligament.

**Acute Onset of Congenital Hernia in Soldiers**—There was a high percentage of acute hernias that occurred during World War I, and World War II. There was usually a history of sudden onset, and operation disclosed a well developed sac, often containing a small amount of fluid. It is probable, in these cases, that only partial obliteration of the processus vaginalis had taken place, and this had been limited to the upper end near the internal ring.

**Inguinal Hernia in the Female**—Inguinal hernia constitutes about 50 per cent of all hernias occurring in females. These hernias are almost always of the external indirect variety and are of congenital origin, being due to an unobliterated process of peritoneum known as the canal of Nuck, which is analogous to the processus vaginalis testis. Obliteration of this peritoneal diverticulum occurs with greater frequency in the female than in the male. Nobbe stated that the canal of Nuck is found in 8 to 10 per cent of female subjects, and a patent processus vaginalis testis is present in 30 to 40 per cent of male subjects. Moolgavkar remarks that the testicle tends to draw down a dimple of preformed sac in males, whereas in females the weight of the uterus pulling on the round ligament corrects any tendency to dimpling and may explain in part the small number of inguinal hernias in females.

**Inguinal Fossae**—The importance of the funnel like depressions of the inguinal fossae as a cause of direct hernia has been pointed out by Joessel Tillaux, Waldeyer, and Tinker. According to Tinker the depth of the fossae varies considerably often being well marked when a hernia is present. In one dissection Tinker found the internal inguinal fossa over  $1\frac{1}{2}$  inches (3 cm.) deep.

**Deficiency of the Conjoined Tendon**—Absence or weakness of the conjoined tendon may be an important factor in the causation of direct hernia and of less importance in the etiology of indirect hernia.

**Fat**—An accumulation of fat in the abdominal wall predisposes to hernia by weakening the muscles and relaxing the rings while the fatty infiltration of the omentum and mesentery increases intraabdominal tension.

**Lipoma in the Inguinal Canal**—A lipoma in the inguinal canal that is adherent to the spermatic cord is almost always attached to the properitoneal fat at the internal ring and by causing a bulging into the canal favors the development of hernia. The lipoma should always be removed at operation to lessen the danger of recurrence. In 154 hernia operations Speed found lipomas in 47.4 per cent.

**Predisposing Causes**—There are several factors that may favor the production of indirect and direct inguinal hernia.

1 **Heredity**—The influence of heredity as a cause of inguinal hernia is uncertain. Cooper believed that the shape of the pelvis plays some part. Macready said that hernia occurs more frequently in subjects whose parents had hernias than in those whose parents were sound. It is probable however that an inherited weakness of the abdominal muscles is just as much of an influence as the existence of hernia in one or both parents.

I recall two patients with inguinal hernia associated with partially descended testis who said that both their father and paternal grandfather had the same condition. In another instance I treated three boys in one family for inguinal hernia. Both parents and the maternal grandmother suffered from hernia. The influence of heredity on the development of hernia has been a subject for investigation by Montagu and by West.

2 **Sex**—Inguinal hernia is very much more common in males than in females. Ninety five per cent of all hernias in males are of the inguinal type while in females only 45 per cent are inguinal. The greater prevalence in the male is partly due to the size of the spermatic cord which is much larger than the round ligament and the processus vaginalis testis is less frequently obliterated than the canal of Nuck.

3 **Age**—Macready also stated that in the first year of life a larger number of persons are living consequently there are more hernias than in any subsequent year. In the first year 175 per cent of males have hernia and 916 per cent of females.

The number of hernias in children and adults is highest during the years of greatest activity. The tendency to hernia increases with age but the exciting causes are less active. After fifty years the reduction in the number of hernias in women is much greater than that in men.

**Frequency of Right and Left Hernias**—The greater frequency of right hernia in the first year and the high proportion until after puberty are due to delayed descent of the testis and to the later closure of the canal on the right side. After the age of twenty there are still more hernias on the right. This is due to nerve damage following appendicitis operations and to the fact that the right hand and leg are more active than the left hence more stress and strain on the right side. Direct hernia appears most often on the right side. Skinner and Duncan in a series of hernia cases found that 627 were on the right side 499 on the left and 121 bilateral. Burton and Ramos state that right inguinal hernia is more common than left and slightly more frequent than bilateral inguinal hernia.

**Traumatic Direct Hernia**—Any operative procedure in the inguinal region may be followed by a hernia usually of the direct variety if the original incision lies internal to the deep epigastric artery. Hernia sometimes follows the operation for shortening the round ligaments and the inguinal operation for femoral hernia or it may follow a fall or a crushing injury.

**Exciting Causes**—The exciting causes of inguinal hernia are those common to all hernias and are more fully described in the chapter on general considerations. Among them may be mentioned the following: injury, constipation, strains such as lifting a weight, coughing as in bronchitis or whooping cough, ascites, urethral obstructions and possible phimosis, a gradual increase in intraabdominal pressure due in infants to a tight umbilical binder or in adults to a tight belt and any factor that produces a sudden increase in intraabdominal tension.

**Artificial Hernia**—Artificial hernias are produced by dilating forcibly the external and internal rings with the finger or with a blunt stick or similar instrument sometimes aided by light blows from a hammer or mallet. It is very painful and often the patient faints during the ordeal. To bring the hernia down after the inguinal ring is dilated the patient takes an emetic to induce retching and vomiting and sometimes snuff to produce sneezing. The hernia usually appears in one to three days. Artificial hernias are induced for the purpose of escaping military duty; the custom is most common in Russia but is practiced also in other countries.

**Right Inguinal Hernia Following Operation for Appendicitis**—Inguinal hernia follows the operation for appendicitis more often than is generally supposed and is due to the division of the nerve supply of the muscles in the region of the internal ring usually the iliohypogastric nerve and sometimes the twelfth dorsal or ilioinguinal nerve.

Hernia may also occur following the destruction of nerves, fascia or muscles by suppuration or by pressure from gauze or tube drains. I have seen inguinal hernia follow the McBurney or muscle splitting operation and also the lateral rectus incision. It is much more frequent after the McBurney incision.

I have seen 200 patients who developed inguinal hernia after an operation for appendicitis. In 185 the time between the appendix operation and the appearance of the hernia was known; in 155 the duration of the hernia was noted.

TIME ELAPSED BETWEEN APPENDIX OPERATION AND APPEARANCE OF HERNIA

YEARS											
Up to											
1	2	3	4	5	6	7	8	9	10	11	
14	11	10	9	1	5	12	5	0	14	4	

YEARS											
12	13	14	15	16	17	18	19	20	21	30	41
6	1	5	10	7	9	19	19	25	10		50

DURATION OF HERNIA

MONTHS						YEARS									
1		2		6		1		1½		2		3		4	
R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
37	2	13	0	1	3	13	6	3	1	11	4	4	3	5	1

YEARS											
6-9		10-19		20-29		30-40		41-50		51-60	
R	L	R	L	R	L	R	L	R	L	R	L
7	2	14	2	1	1	1	2				

Hoguet in an important paper on this subject, reported 190 operations for appendicitis with inguinal hernia following in 8 cases. Griffiths reported 11 cases, 10 of these followed the McBurney incision. Thiessen, in 1944 observed 31 patients who developed inguinal hernia following operations in the right lower quadrant.

A ventral hernia in the scar of the appendix incision may complicate the inguinal hernia. I recall one patient whom I first saw three months after his operation for appendicitis through the McBurney incision. At this time he had a large unruptured abscess in the appendix region and a small right inguinal hernia of two months' duration. I operated on the hernia, and after opening the sac, introduced my finger into the abdomen and easily palpated the appendix abscess two inches (5 cm) above the internal ring. The hernia incision healed by primary union and a week later I opened the appendix abscess and removed the silk sutures which had been used by the first operator, and were probably responsible for the suppuration.

**Double Hernia**—Previously stated that in bilateral indirect inguinal hernia, the hernias occur simultaneously in 4.6 per cent of the males and in 3.1 per cent of the females, of these 48.9 per cent in females appear in the first year of life. As life advances many single hernias become double, 36.6 per cent in males and 23.3 per cent in females. On the other hand double femoral hernia is more common in females. The proportion of double inguinal hernias to the single hernias is 0.64 per cent to 1 per cent.

**Cause of Interparietal Hernias**—Interparietal hernias which include the properitoneal, interstitial, and inguinosuperficial varieties, nearly always occur in males and are generally associated with undescended imperfectly descended or malformed testes. Henrici, in 1892, believed the properitoneal sac was the result of repeated reductions of hernia with a narrow neck.

**Preformed Sac or Congenital Malformation**—At the present time, it is generally believed that interparietal hernias are due to the existence of a preformed congenital peritoneal diverticulum, often associated with developmental anomalies of the inguinal canal (See section on preformed sacs in preceding chapter on anatomy)

**Cause of Bilocular Sacs in Interparietal Hernia**—The sac in properitoneal hernia is nearly always bilocular, in the interstitial and inguinoperitoneal varieties, it may have two loculi, but there is usually only one

**Properitoneal Hernias**—A number of theories have been proposed to explain the development of properitoneal hernias. They are probably always congenital in origin and the bilocular sacs are due to congenital diverticula. The hernia may appear at any time following a strain. In aged subjects the diverticula are sometimes found empty and collapsed.

**Frequency of Interparietal Hernias**—While it is generally agreed that interparietal hernias occur more frequently in males, Langton stated that they are twice as frequent in women as in men, and he gave multiple pregnancies and lax abdominal walls as the principal predisposing factors.

**Inguinoperitoneal Hernia**—Inguinoperitoneal hernia is of congenital origin and is usually associated with mal descended testis. It is due to the development of the perineal portion of the gubernaculum which causes the testis, accompanied by its processus vaginalis testis to descend into the perineum instead of into the scrotum. This variety of mal descended testis is more frequent than are the crural or pubopneule varieties.

### Direct Inguinal Hernia

Direct inguinal hernia occurs most often in men between the ages of forty and fifty years. It is very rare in children. In 430 operations for inguinal hernia in children reported by Andreu there were 2 cases of the direct variety. It is more often bilateral than the oblique. Murray stated that 55 per cent of these hernias are bilateral. Finocchetto believed that 10.3 per cent of all inguinal hernias treated by operation are direct.

Direct inguinal hernia is seldom congenital but is due to the same causes that produce hernia in the linea semilunaris as a matter of fact direct hernia comes through the lowest part of the linea semilunaris, which is the weak spot in Hesselbach's triangle. For this reason many writers consider direct inguinal hernia as a variety of hernia in the linea semilunaris (Figs 35-37). Fallis believes that separation or stretching of the transversalis fascia is a causative factor in direct hernia.

Direct inguinal hernia was first described by Heister in 1724, and Camper dissected a case in 1759. In 1771 Monro saw a case and called it ventroinguinal hernia. Scarpa also believed direct hernia was a combination of the inguinal and ventral varieties. Cooper, who saw 6 cases, called attention to the danger of severing the deep epigastric artery when relieving the constriction of strangulation. Hesselbach first wrote on inguinal hernia in 1806, and in 1814 his classic monograph appeared.





Fig 3 —Right direct inguinal hernia of two years' duration. There is an oval or globular swelling opposite the external ring. This variety of hernia seldom descends into the scrotum.



Fig 36 —The same patient. Note the absence of bulging over the inguinal canal and at the internal ring.

**Frequency of Direct Inguinal Hernia**—Direct inguinal hernia is infrequent, constituting only about 5 to 7 per cent of all inguinal hernias

**Direct Hernia Following Operation for Indirect Inguinal and Femoral Hernia**—Direct hernia occasionally follows a successful operation for indirect inguinal hernia and it occurs rarely after an inguinal operation for femoral hernia. In these cases it is probable that a small congenital diverticulum existed and was overlooked at the first operation. The reduction of the first hernia with the consequent increase in intraabdominal tension along with the weakening and stretching of Hesselbach's triangle caused by the deep sutures sometimes is sufficient to bring on a direct hernia.



Fig. 3.—Bilateral direct inguinal hernia.

I operated on a patient for indirect inguinal hernia and a year later he returned to me with a direct hernia on the same side of six months standing. At operation I found that the direct hernial sac was nearly two inches (5 cm.) long and was confined to Hesselbach's triangle. I carefully examined the indirect inguinal region and noted that on the peritoneal side there was no relaxation or puckering of the peritoneum and the cord was tightly encircled by the internal ring. The internal oblique muscle and the conjoint tendon showed no evidence of atrophy and were so firmly attached to the inguinal ligament that they could not be separated by blunt dissection and it was necessary to use scissors to divide them before the deep sutures of the direct hernia operation could be placed. This case affords evidence that sometimes union takes place between the internal oblique conjoint tendon and the inguinal ligament provided these structures are perfectly approximated by the deep sutures.

**Causes of Irreducibility**—The following changes are liable to occur in unreduced hernias: adhesions form between the hernial contents and between



Fig 1 —Right direct inguinal hernia of two years duration. There is an oval or globular swelling opposite the external ring. This variety of hernia seldom descends into the scrotum.



Fig 30—The same patient. Note the absence of bulging over the inguinal canal and at the internal ring.

**Frequency of Direct Inguinal Hernia**—Direct inguinal hernia is infrequent constituting only about 5 to 7 per cent of all inguinal hernias

**Direct Hernia Following Operation for Indirect Inguinal and Femoral Hernia**—Direct hernia occasionally follows a successful operation for indirect inguinal hernia and it occurs rarely after an inguinal operation for femoral hernia. In these cases it is probable that a small congenital diverticulum existed and was overlooked at the first operation. The reduction of the first hernia with the consequent increase in intraabdominal tension along with the weakening and stretching of Hesselbach's triangle caused by the deep sutures sometimes is sufficient to bring on a direct hernia.



FIG 3 Bilateral Direct Inguinal Hernia

I operated on a patient for indirect inguinal hernia and a year later he returned to me with a direct hernia on the same side of six months standing. At operation I found that the direct hernial sac was nearly two inches (5 cm) long and was confined to Hesselbach's triangle. I carefully examined the indirect inguinal region and noted that on the peritoneal side there was no relaxation or puckering of the peritoneum and the cord was tightly encircled by the internal ring. The internal oblique muscle and the conjoint tendon showed no evidence of atrophy and were so firmly attached to the inguinal ligament that they could not be separated by blunt dissection and it was necessary to use scissors to divide them before the deep sutures of the direct hernia operation could be placed. This case affords evidence that sometimes union takes place between the internal oblique conjoint tendon and the inguinal ligament provided these structures are perfectly approximated by the deep sutures.

**Causes of Irreducibility**—The following changes are liable to occur in unreduced hernias: adhesions form between the hernial contents and between

the contents and the sac wall, the pressure of the neck of the sac causes the portion of the contents at that point to decrease in size, fat is deposited in the appendices epiploicæ, and in the omentum and mesentery in the fundus of the sac, with the result that the hernial contents are larger than when they first came down, and an accumulation of intestinal contents, due to partial obstruction of the distal loop, may take place in the hernial sac. Newgrowths, abscesses or tuberculous of the hernial contents may also cause irreducibility.

**Frequency of Irreducibility.**—Irreducibility occurs most often in subjects between thirty and sixty years of age in both sexes. It is rare in children because their hernias are usually enterocœles (90 per cent). Less than 0.5 per cent of the hernias in males under sixteen years of age are irreducible.

**Irreducibility of Omentum.**—On account of the early formation of adhesions, the omentum is not only the most difficult part of the hernias to reduce, but it is the usual cause of irreducibility (90 per cent).

**Causes of Strangulation.**—The points of strangulation in the order of their frequency are (a) the edge of the internal ring, (b) the edge of the external ring, (c) in the inguinal canal, due to constriction by the fibers of the transversalis or internal oblique muscles, (d) in the neck of the sac as a result of pathologic changes.

In direct inguinal hernia, strangulation is rare, but when it occurs it is usually at the external ring. Hemorrhage occurring within the intestine lying in the hernial sac is one of the usual causes of strangulation. Overdistention of the portion of the bladder lying in the hernial sac is sometimes a cause of partial strangulation.

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## CHAPTER XI

### INTERSTITIAL HERNIA

**Synonyms**—External prevesical hernia, interparietal hernia, intraparietal hernia; intermuscular hernia, preperitoneal hernia, subcutaneous inguinal hernia, prefascial hernia, preaponeurotic interstitial hernia (Leeles), incomplete inguinal hernia (Velpeau), intramarginal hernia (Boyer), hernia of Goyrand, Küster's hernia

**Definition**—Interstitial hernia is a hernia that lies in one or the other of the planes of the abdominal wall

#### Historical

This type of hernia was first observed by Bartholin, in 1661, in a man thirty years old. The mass was large and extended upward into the hypogastrium toward the spleen. Bartholin called it a "bubonocoele rara." Petit, in his work on surgery, described interstitial hernia in 1700. Dance wrote on the subject in 1835, and, as early as 1861, the hernia was well known to Birkett who urged the general adoption of the term "interstitial hernia" which had been used by Goyrand in 1836 when he wrote "The viscera issued from the abdomen through the superior orifice of the inguinal canal, or by an abnormal opening in the fascia superficialis, instead of passing through this canal to break through the external orifice, it lodges in the cavity which it dilates, and in the interstice of the abdominal wall." Velpeau, in 1851, also discussed interstitial hernia.

Inguinosuperficial hernia was described with detailed anatomical studies by Kriemlein, in 1875. It was also described by LeFort, and by Küster in 1886. Around the turn of the century the subject attracted considerable attention from anatomists and surgeons, and a number of papers were published on inguinosuperficial hernia.

Lower and Hickin, in 1931, collected the cases in the literature. Levitsky in 1936, discussed its etiology, and Panushkin, in 1937, noted its occurrence in children. San Miguel, in 1937, emphasized the dangers of strangulation. Dunphy, in 1939, wrote on diagnosis, important papers were published by Edington in 1942, Manfredonia, and Thunig, in 1943, Cattell and Aronoff, Godfrey, and Hone and Newson, and Gray and Horwitz in 1944, Fisher, in 1946, Dickinson, in 1946, and Koontz, in 1947, reported 2 cases.

Macready believed that in some cases the resistance to the advance of the hernia produced a bilocular sac, and he cited a specimen in Guy's Hospital Museum which was taken from the body of a woman who had a right obturator hernia, with a second pouch behind the obturator internus muscle.

# Varieties of Interstitial Hernia

Interstitial hernias are divided into four general groups

- 1 Properitoneal
- 2 Intermuscular
- 3 Inguiosuperficial
- 4 External suprapubic

**Statistics**—Interstitial hernias are not rare as attested by the fact that Lower and Hicken were able to collect in the literature 119 cases of properitoneal 348 of interstitial or intermuscular and 123 of superficial inguinal (Figs 38-40)

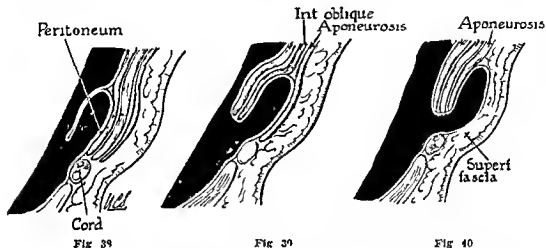


Fig 38—Properitoneal hernia. The sac lies between the peritoneum and the transversalis fascia.

Fig 39—Interstitial or intermuscular hernia. The sac burrows between the muscles of the abdominal wall.

Fig 40—Superficial inguinal hernia. The sac lies between the external oblique aponeurosis and the skin.

**1 Properitoneal Hernia**—In properitoneal hernia the sac burrows between the peritoneum and the transversalis fascia. The hernia is usually composed of two sacs which may be hourglass shaped or bilocular. The inner or intraperitoneal portion usually lies between the peritoneum and transversalis fascia and as a rule is directed toward the anterior superior spine of the ilium, sometimes it extends downward toward the bladder (vesical variety) and rarely toward the obturator foramen (obturator variety). Fisher reported 8 cases in which the hernia followed operations for appendicitis. In each instance the omentum passed through a defect in the peritoneum at the McBurney incision and then under the transversus abdominis and internal oblique muscles to the inguinal canal finally reaching the external inguinal ring where it simulated an ordinary inguinal hernia. Jeremian observed a similar case.

McNealy observed a rare case of spontaneous interstitial hernia beneath the internal oblique and transversalis near McBurney's point (Fig 41).

The properitoneal sac may sometimes become quite large. The outer or superficial portion which is often empty may be in the inguinal canal or very frequently in the femoral canal or between the layers of the abdominal wall as in the intermuscular or inguiosuperficial types.



The external inguinal ring may be normal or even dilated especially when there is a loculus in the scrotum or it may be absent, or it may be so small as to admit only a nerve as in the case observed by Tullux. All of these hernias that have bilocular sacs communicate with the abdomen. It should always be borne in mind that this is the type of interstitial hernia that most frequently strangulates *en masse*.

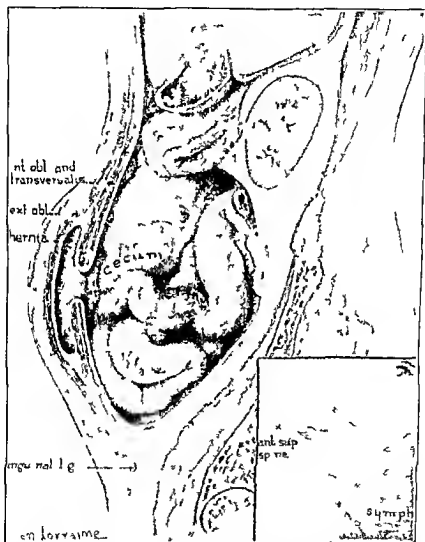


Fig 41.—Spontaneous interstitial hernia developing without trauma or a previous operation (Courtesy Dr R W McNally.)

**2 Intermuscular Hernia**—Intermuscular hernia is frequently indirect and may be due to an anomaly of the testis. The hernia passes through or rests between the peritoneal muscular or fascial layers of the abdominal wall. It does not make an exit at the external inguinal ring. In these intermuscular hernias

the sac burrows (a) between the transversalis muscle and fascia, (b) between the fibers of the internal and external oblique muscles, (c) between the transversalis fascia and the external oblique muscle or aponeurosis (true interstitial hernia). (Figs. 42-44.)

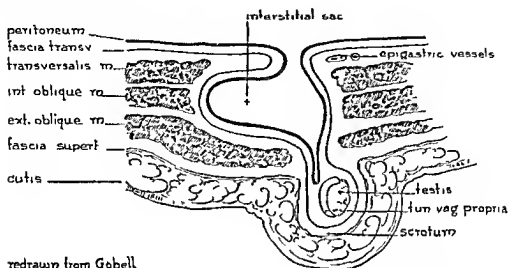


Fig. 42.—Interparietal inguinal hernia between the external oblique and the transversalis.

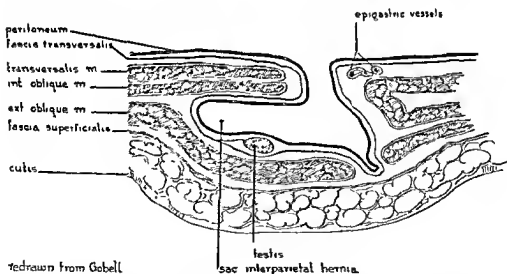


Fig. 43.—Interparietal inguinal hernia between the internal and the external oblique.

Interstitial inguinal hernias in women were described by Berger in 1891, and by Auvray in 1900. The hernia may be entirely between the layers of the abdominal wall (17 cases collected by Auvray), or it may be bilocular, with the outer loculus prolonged into the labium majus. There is more of a tendency for this hernia to extend toward the anterior superior spine in women than in men. Langton collected from the literature 50,000 cases of inguinal hernias in males, and found records of only 42 cases of interstitial hernias.

**3 Inguinosuperficial Hernia**—In inguinosuperficial hernia the sac lies between the external oblique aponeurosis and the skin. After passing through the external ring the sac rests in the subcutaneous tissues above it, more frequently extending in the direction of the anterior superior spine. Broca has seen it extend nearly to the umbilicus and I have seen a loculus of the sac descend into the femoral region.

Inguinosuperficial hernia is almost always associated with undescended or maldescended testis, however, at times the testis is found in its normal position at the bottom of the scrotum. This hernia, which is probably due to a patent congenital diverticulum, presents the signs of a soft fluctuating tumor in the groin and the testis can almost always be detected in the mass. This hernia is much more frequent than is generally supposed. Rarely a post-operative hernia may burrow under the muscles or fascia as in the case reported by Dunphy.

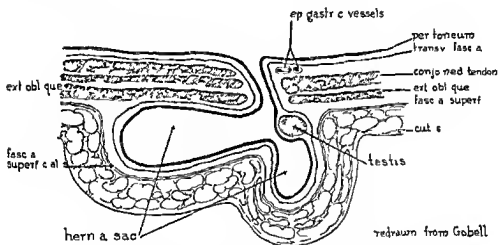


Fig 44 Superficial inguinal hernia between the external oblique and the superficial fascia

**4 External Supravesical Hernia**—This variety of interstitial hernia may appear at either of the following points: (a) between the conjoined tendon and the aponeurosis of the external oblique; (b) subcutaneously in front of the aponeurosis of the external oblique. Reich in 1909 collected 26 cases of this variety of hernia from the literature. This is not an unusual type of hernia but because of a confusing nomenclature and the numerous titles that have been used in describing supravesical hernia it is too often confused with internal supravesical hernia which is very rare. External supravesical hernia may appear in the hypogastrium in the inguinal, femoral or obturator regions.

#### Symptoms and Diagnosis

The symptoms are those of external hernia and the diagnosis should be made without difficulty. Because the hernia is accompanied by an external

swelling or irreducible mass, it does not present the diagnostic difficulties inherent to internal supravesical hernias which present no external evidence of hernia

### Prognosis

The prognosis depends much on the early diagnosis and prompt operation especially if strangulation of the intestine is a complication. The mortality rate is higher than with the ordinary type of hernia, depending on its location. The death rate is lower than in internal supravesical hernia described elsewhere.

### Treatment

The treatment of interstitial hernia is much the same as abdominal, inguinal, femoral, and obturator hernia. When a double sac is found or a diverticulum burrows between the planes of the abdominal wall or extends beyond the main sac, it should be dissected out. If this is impractical, the edges of the diverticulum should be peritonized and closed with interrupted sutures. If an interstitial hernia is suspected, and the possibility should always be borne in mind when the symptoms are unusual or obscure, a combined abdomino-inguinal incision is to be advised. At least the inguinal incision should be extended upward beyond the usual limits so as not to overlook a hidden sac or diverticulum.

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## CHAPTER XII

### INTERNAL SUPRAVESICAL HERNIA

**Synonyms**—Prevesical hernia paravesical hernia properitoneal supra vesical hernia, suprapubic hernia hernia into the fossa supravescalis and fossa supravescalis hernia paravesicalis intravesical hernia internal inguinal hernia, anterior retroperitoneal hernia retroperitoneal hypogastric hernia, vesicinguinal hernia and vesicopubic hernia

**Definition**—A protrusion of abdominal viscera into the supravescal fossa

#### Historical

The first reference to the supravescal fossa is found in Sir Astley Cooper's monograph *On Hernia* published in 1804 illustration plate No 8 shows two openings in the supravescal space. It remained for Ring to report a probable supravescal hernia in 1814 while the first authentic case was seen by Linhart in 1876. Parise in 1851 made an extensive study of internal hernias and reported a case of *hernie inguinale antecusale*. Waldeyer in 1874 was the first to suggest the term internal supravescal to describe these hernias. Havige in 1878 found a hernia in the vesicopubic fossa during an autopsy. Iromme in 1908 made the first preoperative diagnosis that has been reported for internal supravescal hernia.

Reich in 1909 after carefully searching the literature and checking the many titles that had been used to describe internal supravescal hernias found 16 cases. Important papers were published by Walker in 1933 and Pick, in 1937.

Stalker and Gray, in 1939 reported a strangulated hernia into the space of Retzius, the only one up to that time in a group of 23 cases of internal hernias seen at the Mayo Clinic. Wakeley in 1940 described an unusual case of strangulation into a supravescal peritoneal sac that admitted 3 fingers to the extent of 3 inches (7.5 cm), lying in front of the bladder. Wakeley found 10 similar cases in the literature described as "prevesical hernia". In 1943 Berson reported a case and Downing in 1945 added another to the literature.

**Statistics**—Warvi and Orr in 1940 collected 37 cases of internal supra vesical hernia in the literature also the records of 11 hernias found at autopsy. They believe this type of hernia to be rare though more frequent than published reports indicate. Watschugoff found 3 internal supravescal hernias in the course of 1500 hernia operations and he states that probably 0.2 per cent of all hernias that come to operation are of this type.

In 40 cases of internal supravescal hernia I collected from the literature 36 were males and four females, 16 were on the right side and 16 on the left,

only 5 of the patients were between twenty and thirty years of age while 21 patients were 1st fifty years old

Internal supravescical hernia has been described under more different names than any other hernia. This accounts for the few cases that have been reported under any one title. Warren and Orr in 1940 were able to find 9 different terminologies in the literature each describing the same variety of supravescical hernia. Their excellent monograph is the most complete that has been written on internal supravescical hernia.

### Varieties of Supravescical Hernia

Supravescical hernia is usually divided into 3 groups (a) *internal* (b) *external* (c) *interstitial*. Because of the confusion of terms and the difficulty



Fig. 45—Internal supravescical hernia between bladder and symphysis pubis

of differential diagnosis, it has been thought advisable to consider internal supra vesical hernia as a separate entity, and describe the external and interstitial varieties in a separate chapter. Because of the terminology, these hernias are also confused with hernias of the bladder (Fig 45)

Warvi and Orr state that internal supra vesical hernia may be prevesical, intravesical, paravesical or lateral vesical, dependent upon lodgment in the space of Retzius, in the bladder, or in the more lateral pelvis. A supra vesical diverticulum can herniate in various directions and into different locations. A majority protrude externally into the hypogastrium, and Warvi and Orr mention five different directions that hernia may take in its course.

### Anatomy

Callander states: "The internal inguinal fossa, or supra vesicular space, is bounded laterally by the obliterated umbilical artery and medially by the urachus. At this level the abdominal wall offers considerable resistance to intraabdominal pressure because of the presence of the inguinal falx (conjoined tendon). A hernia very rarely originates here because of these structures."

### Etiology

The cause of internal supra vesical hernia is not known. Finsterer maintained that it is chiefly embryological and is due to an abnormal depth of the supra vesical fossa as a result of faulty regression of fetal structures.

Other contributing factors, common to most hernias, are congenital muscle or tissue weakness or malformation, an associated abdominal hernia, an increase in intraabdominal pressure from obesity, ascites, etc., as well as extreme or sudden loss of weight which was prevalent in Germany after World War I and in France and adjacent countries following World War II.

Walker believes that increased prominence of the lateral and middle umbilical folds is unquestionably a factor in the production of peritoneal pockets.

### Symptoms

The patient usually gives a history of pain of a cramplike character at irregular intervals before the final attack of irreducibility or strangulation. There is often a gradual loss of weight, insomnia, and increasing urinary symptoms. The latter are too often attributed to prostate enlargement and obstruction, especially in men of advanced years. The urinary symptoms and pain over the bladder vary with the pressure on the viscus as well as the amount of bladder displaced by the hernia.

Internal supra vesical hernia usually occur in men between twenty and seventy five years of age. Finally, the patient may experience severe pain, nausea, vomiting, and abdominal distention as a result of intestinal obstruction or strangulation. Internal supra vesical hernias are much more difficult to diagnose than are external supra vesical hernia. In the latter, there is often a swelling or mass in the abdominal wall to aid



### Diagnosis

Preoperative diagnosis is almost impossible though it has been made. Lomme was able to make such a diagnosis before operation with a preliminary cystoscopic examination which disclosed a bulging of the anterior wall of the bladder. Occasionally the patient is too ill for a cystoscopic examination. Warri and Orr urge a scout film as an invaluable aid to diagnosis, also a cystoscopic examination to determine bladder displacement and contour. If these procedures are not available and the patient has tenderness over the bladder with symptoms of intestinal obstruction an internal suprapubic hernia should be suspected (Fig 46).

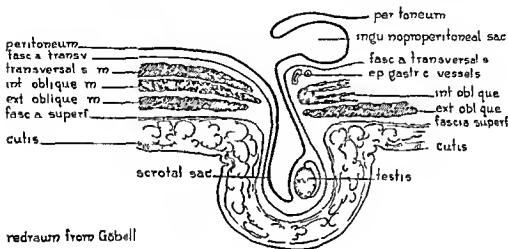


Fig 46—Internal suprapubic hernia with biocular sac

### Prognosis

As is the case of any patient with an internal hernia there is no visible external mass and for this reason the symptoms are often obscure and out of all proportion in severity to the patient's apparent condition. Little time should be spent in attempting to make a preoperative diagnosis which is possible but highly improbable. A prompt exploratory operation gives the patient the most favorable chance for recovery.

Warri and Orr state that in 34 reported cases with known results there were 15 deaths—a mortality rate of 44.1 per cent.

### Treatment

After relieving the strangulated intestine or other viscera and dealing with it as conditions demand, attention should be directed to the hernial sac. It is seldom advisable to attempt to remove the sac because the patient is usually in a serious condition from age or delay in coming to operation. Besides, with the pressure of the hernia removed, the bladder quickly expands and fills the space. To prevent a recurrence of the hernia, freshen or peritonize the edge of the hernial ring and close with interrupted sutures of cotton or silk.

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## CHAPTER XIII

### SYMPTOMS, DIAGNOSIS, AND PROGNOSIS OF INGUINAL HERNIA

Inguinal hernia presents the general symptoms common to all hernias, and additional ones that are due to the special conditions in the inguinal region.

The indirect variety will be considered first, because it constitutes a majority of all hernias, and then the symptoms of direct hernia will be taken up.

#### FUNCTIONAL SYMPTOMS

**Symptoms of Beginning Hernia (First Stage)**—The first stage of inguinal hernia is usually characterized by an uneasiness in the epigastrium, without actual pain, and often a "dragging sensation" referred to one of the costal margins and pain in the back corresponding to the ninth and tenth ribs.

I have noticed that in young infants there is sometimes a history of the baby having cried a great deal for a week or two previous to the onset of the hernia. Possibly the crying is the cause of the hernia, instead of a symptom.

**Bubonocoele or Incomplete Hernia (Second Stage)**—When the hernia has passed through the internal abdominal ring into the inguinal canal, it is known as a bubonocoele. At this stage diagnosis may be difficult, and in infants the only symptoms may be restlessness and a slight bulging on crying.

**Complete Hernia (Third Stage)**—When the hernia has passed the external ring it is known as a complete hernia. While it may not enlarge immediately, the tendency is for it to descend finally into the scrotum, when it becomes a scrotal hernia (Figs 47 and 48). In the female the hernia descends into the labium majus when it is known as a labial hernia.

Scrotal hernias, as well as the bubonocoeles, cause pain, gastrointestinal disturbances, nervousness and irritability. Pain over the internal abdominal ring may be one of the first symptoms of beginning hernia, it may be a cutting, burning or prickling sensation. Pain over the abdomen, usually in the region of the umbilicus, is also common and is often associated with nausea that follows traction on the mesentery. If traction is continuous, vomiting will result. Sometimes the pain is referred to the back especially with the large hernias, in which pain of some sort is seldom absent. Hyperesthesia over the hernia or over the testis on the affected side is occasionally complained of.

I recently operated on a man, sixty-eight years old for recurrent hernia that reached nearly to his knees. The sac contained omentum, small intestine, and a portion of the bladder wall. The only symptom the patient complained of was painful frequent urination, every ten to fifteen minutes when he was on his feet. Medical treatment had afforded no relief. After operation, which restored the bladder to its normal position, the pain disappeared and micturition was reduced to four to six hour intervals.



\* Fig 47—Complete inguinal hernia. Right indirect inguinal hernia of two years duration. The hernia has entered the scrotum. The testicle can be seen lying below the hernia.



Fig 48—The same patient. Note the bulging over the inguinal canal.

Prodromal pain along the course of the ilioinguinal and genitoexternal nerves may be the first symptom of a beginning hernia. It is most frequent in the testis or along the side of the scrotum or labium majus. When the external abdominal ring is being dilated it is sometimes noticed there. It may rarely be referred to the side of the penis, to the hip, or into Scarpa's triangle. Carp has discussed the diagnosis of small and obscure hernias.

**Painful Hernia.**—Abdominal pain is unusual with inguinal hernia. It is often referred to the lumbar region or the back, occasionally to a point near the umbilicus. I recently observed a hernia of this type in a young man. Several surgeons had examined him and failed to find any evidence of hernia. Treatment of a small interstitial hernia relieved his symptoms. Cattell and Aronoff report an obscure case of painful hernia that was promptly relieved by operation. The possibility of a painful hernia being due to complicating appendicitis should always be borne in mind.

**Gastrointestinal Symptoms.**—When intraabdominal symptoms referable to the gastrointestinal tract accompany a hernia, the patient must be subjected to a painstaking examination so as to exclude a possible complicating intraabdominal ulcer, malignancy, or other disease. This is especially important in those past middle age. Myers and Zollinger stated that gastrointestinal symptoms occur in approximately one fifth of the patients with inguinal hernia, and the cause of the symptoms must be established before the operation is advised.

**Objective Signs.**—Beginning indirect inguinal hernias that bulge only at the internal ring are more easily seen than felt. With the patient reclining in a good light, a slight bulging may be seen on the affected side when he coughs or strains, and a definite impulse is obtained on palpation.

Hernias that have entered the inguinal canal or passed beyond it are diagnosed easily as a rule by the presence of a tumor that gives an impulse on coughing when the patient is standing up. This impulse is the most important sign of hernia, and the examiner can detect it readily by placing his hand over the inguinal region or by passing his finger up the inguinal canal when the external ring is dilated.

To explore the canal, place the index finger on the testis and push upward through the external ring at the same time invaginating the scrotum. The spermatic cord will be felt at the point where it passes over the os pubis; follow it back with the finger to the internal ring, where an impulse on coughing will be felt in indirect inguinal hernia. In direct inguinal hernia, instead of passing obliquely outward to the internal ring, the finger will enter the abdominal cavity directly behind the external ring, and the cord will be to the outer side. A small hernia can be diagnosed by a bulge on coughing or lifting a weight while standing with the legs apart. The fact that the external ring admits the tip of the examining finger is not positive evidence of the existence of a potential hernia.

In large indirect hernias the inguinal canal loses its obliquity owing to the dilatation of the internal ring, which may reach the outer border of the rectus muscle. In this case the internal ring is directly behind the external ring. A complete obliteration of the inguinal canal is rare, and it is usually possible

to find enough of the inguinal canal remaining to preserve the oblique direction of the neck of the sac. **Chernier** stated that the internal arch formation of the transversalis and internal oblique muscles should be the primary consideration in all examinations because it is the active preventive of viscus exit.

In direct hernia the epigastric artery is at the outer side of the aperture, but on account of its small size and the nature of its coverings, it cannot be felt. Those who pretend to feel it surrender themselves to a flattering delusion (*Maerendy*).

**Percussion**—If the hernia contains intestine near the surface, a resonant note can be elicited on percussion unless the intestine is collapsed, contains fluid, or is covered by a layer of omentum. **Fabre** was able to diagnose an inguinal hernia of the stomach during life, because the mass became dull on percussion immediately after the patient ate or drank.

**Reflex Objective Signs of Beginning Hernia**—According to **Cosens**, who examined 20,000 soldiers, the rectus muscle on the affected side is often more tense than the one on the sound side. With the patient in the erect position and head up, pressure over the external rings will cause him to complain of pain on the weak side. There is often pain referred to a point above the umbilicus.

**Reducible Hernia**—If the hernia contains small intestine, the last portion often reduces suddenly and with a gurgling sound if it contains fluid. Occasionally the coils of intestine can be seen through the sac wall if it is thin. A sac that contains omentum is often irregular in shape, and the fatty lobules can sometimes be felt. Appendices epiploicæ may be mistaken for omentum. Omentum reduces more slowly than intestine and without gurgling.

In irreducible hernias it is usually impossible to distinguish the contents unless the sac is very thin.

**The Diagnosis of Direct and Indirect Hernia**—It may sometimes be impossible to differentiate a small incomplete indirect hernia with obliteration of the conjoint tendon from a direct hernia, except at time of operation. Much helpful information may be gained if the patient stands in a good light and coughs or, better, strains, with the legs outspread. Next, have the patient repeat the straining with the fingers of the examiner's hand palpating the inguinal canal and Hesselbach's triangle. Finally, examine the hernia with the forefinger in the external ring, noting the size and muscle and fascia development, especially of the floor of the inguinal canal.

A direct hernia can usually be diagnosed when the examining finger can be passed over the pubic bone and behind it into the abdomen with the cord lateral and not connected with the sac. This indicates that the transversalis fascia and conjoint tendon are absent or very deficient.

**Properitoneal Hernia**—The symptoms of properitoneal hernia are often indefinite, and diagnosis is seldom made before operation. There is usually no swelling in the inguinal region to indicate hernia. When strangulation occurs, it is usually mistaken for intestinal obstruction. The hernial sac accompanying the cord may be empty or it may contain contents that are easily reducible, while the loculus of the sac which is properitoneal, will be found to contain the strangulated intestine.

A fullness over the iliac region, complicated by an undescended testis should lead the examiner to suspect a properitoneal hernia. Properitoneal hernia is sometimes mistaken for an ordinary inguinal hernia reduced *en masse*.

**Interstitial Hernia.**—Interstitial hernia is easier to diagnose than the properitoneal variety, because it is more superficial, lying between the aponeurosis of the external oblique and the internal oblique muscles. It is usually associated with undescended testis which may make diagnosis confusing.

Strangulated interstitial hernia may be mistaken for appendicitis as in the case reported by Rowlands in which the symptoms had persisted for three days and at operation a linking of the cecum in an interstitial hernia was discovered.



Fig 49—Massive irreducible left inguinal hernia (hernia magna) in a man (Courtesy of Dr. A. M. Collins)

**Inguinosuperficial Hernia.**—Inguinosuperficial hernia lies on the aponeurosis of the external oblique and is almost always associated with the undescended testis. The sac passes out through the external ring and pressure at this point will prevent the descent of the hernia just as it will in indirect reducible inguinal hernia.

**Massive Hernias.**—Very large hernias are usually irreducible and may rarely contain nearly all the movable abdominal viscera which may cause severe gastrointestinal symptoms such as colic, nausea, vomiting, constipation and occasionally vesical disturbances.

These hernias may reach below the knees and may totally incapacitate the patient who often complains of a severe dragging pain and a sensation of weight. (Figs 49 and 50)

**Scrotal Hernia.**—After the hernia passes the external ring, it meets with little resistance in the upper part of the scrotum and rapidly passes downward to the bottom of the scrotum. It is usually pear shaped, with the neck above at the external ring (Fig. 51.)

**Inguinal Hernia in Women.**—In examining women for small inguinal hernia, it is sometimes difficult to locate the external ring. I have found the following procedure helpful: place the finger near the external ring and direct the patient to cough; the sac can be felt as it bulges at the external ring, and the palpating finger easily follows the sac back into the inguinal canal.



Fig. 50—Massive irreducible left inguinal hernia in a woman (Courtesy of Dr. E. A. Balloch.)

**Complications.**—A contusion of a hernia may result in injury to the intestine, in the formation of a hematoma, either in the sac or in the subcutaneous tissues; and in a tear of the sac and overlying structures, followed by extrusion of the hernial contents. Other complications are: foreign bodies in the





Fig. 51.—Large lateral reducible inguinal hernia in a man aged seventy-one years. The tumor is pear-shaped with the neck above at the external ring.



Fig. 52.—Massive irreducible left inguinal hernia in a man. The penis has completely disappeared from view and there is a large ulcer involving the lower part of the scrotum. (Courtesy of Dr. A. O. Stagge.)

sic epiploitis, newgrowths either in the sac or in adjacent structures such as disease of an ectopic testis, intrascrotal constrictions and old voluminous hernias that cannot be controlled by any kind of retentive appliance.

A number of cases of reducible inguinal hernia have been reported in which accidental blows on the tumor were followed by rupture of the intestine.

**Compression of Cord by a Hernia.**—Yannicelli has called attention to the danger of pressure on the spermatic cord by a hernia, especially in infants and young children. The symptoms are first pain and swelling of the testis and later atrophy unless the compression exerted by the hernia is relieved.



Fig. 53.—Enormous reducible left scrotal hernia. (Courtesy Dr. Bradley L. Coley.)

**Massive and Irreducible Hernias.**—In massive hernias which are usually irreducible the sac may contain more or less of the following viscera: large and small intestine, omentum, bladder, stomach, liver, spleen, pancreas, and in the female the pelvic organs. In obese subjects these large hernias cause a slipping of the abdominal wall. In men the penis disappears within the tumor; the urine causes frequent excoriations and occasionally ulcerations, complicating conditions (Figs 52 and 53). Amor has given considerable study to the surgical treatment of very large hernias.

When enormous hernias are associated with hydroceles they are called *Gibbon's hydrocele*

**Strangulated Hernia**—Strangulation is the most common complication of indirect inguinal hernia. It is rare in direct hernia but when it occurs it is usually at the external ring. The possibility of additional constrictions as well as a properitoneal hernia or one that has been reduced *en masse* should always be borne in mind while operating for strangulation.

The diagnosis of strangulated inguinal hernia is sometimes difficult especially in children in whom vomiting and gastrointestinal disturbances from other causes are common. The diagnosis is based on the finding of an irreducible inguinal hernia or the history of one that has been reduced *en masse* and the symptoms of intestinal obstruction. As a rule, all symptoms are less severe in the old than in the young in old hernias than in new ones and in omentoceles than in enteroceles. (The differential diagnosis is similar to that of irreducible nonstrangulated hernia and is considered in the section on differential diagnosis.)

Strangulation of a previously reducible hernia is often accompanied by a severe colicky pain which increases in violence as the strangulation progresses. Old irreducible hernias cause a certain amount of pain and discomfort all the time and the pain of a beginning strangulation is less definite than in the reducible variety.

As the condition continues obstruction becomes absolute and is almost always followed by vomiting—first of the stomach contents then fecal matter from reverse peristalsis of intestines. The pulse becomes rapid and thready, collapse and shock are marked and the temperature at first elevated usually becomes subnormal. When death takes place it is almost always due to shock, cardiac failure, peritonitis, inanition or uremic coma.

**Strangulated Hernia in the Female**—Strangulated hernia in the female is rare due probably to the fact that inguinal hernia is not common in women and when it does occur it seldom becomes large.

**Complications of Strangulated Hernia**—The complications of strangulated hernia are gangrenous intestine, perforation with an abscess in the sac, fecal fistula and peritonitis.

**The Hernial Rings**—The examination of the hernial rings should be routine by so doing many of the pitfalls of a mistaken diagnosis will be avoided. A small hernia irreducible or strangulated at the internal inguinal ring is sometimes mistaken for appendicitis. Garlon Taylor has discussed the subject most thoroughly.

## DIFFERENTIAL DIAGNOSIS

The differential diagnosis of inguinal hernia can be most conveniently considered under the following headings:

- 1 The differential diagnosis of direct and indirect inguinal hernia
- 2 The differential diagnosis of inguinal hernia from other diseases

The differential diagnosis of complete inguinal hernia

I Reducible

II Irreducible

The differential diagnosis of incomplete inguinal hernia

I Reducible

II Irreducible

### The Diagnosis of Direct and Indirect Hernia —

#### DIRECT AND INDIRECT INGUINAL HERNIA

##### DIRECT HERNIA

Rare  
Globose in shape  
Spermatic cord in front and external  
Situating high and at outer border of rectus  
Does not descend into scrotum

Often history of sudden onset after trauma  
Is uncommon before the age of 30 years

##### INDIRECT HERNIA

Common  
Pear shaped  
Cord usually behind and internal  
Usually in the scrotum with the neck of the sac further to the side than in the direct variety  
Often appears without any apparent cause  
May appear at any age

It may sometimes be impossible to differentiate a small incomplete indirect hernia with obliteration of the conjoint tendon from a direct hernia, and diagnosis must be made at operation

#### Summary of Differential Diagnosis of Direct and Indirect Hernia —

(1) *Point of bulging* Indirect hernia appears over the inguinal canal. Direct hernia is near the pubic spine

(2) *Size of hernia* Direct hernia presents oval, domed, or saucer shape with broad base. Indirect hernia has fingerlike sac through inguinal canal and rings, often in scrotum, large mass with narrow neck

(3) *Reducibility* Indirect are frequently irreducible. Direct almost never strangulate. Direct hernias reduce quickly on reclining. Indirect recede slowly, often with difficulty

(4) *Irreducible* Direct hernias very rarely are irreducible or strangulate. Indirect hernias if large are at times irreducible

(5) *Bilateral hernias* are usually direct. Unilateral type are nearly always indirect

(6) *In women and children* direct hernias are very rare, and they are infrequent in men under twenty years of age

#### Diagnosis of Inguinal Hernia From Other Diseases —

1 *Differential Diagnosis of Complete Reducible Inguinal Hernia.*—In the male the conditions that most frequently cause enlargement in the scrotum which diminishes on pressure or may disappear, are scrotal hernia, varicocele and congenital hydrocele

In the female the diagnosis of inguinal hernia is much easier than in the male. The only reducible swelling likely to be encountered in the female is varicosity of the labial veins, which usually appears during pregnancy. The differential diagnosis between complete inguinal hernia and femoral hernia is usually simple in either sex

HERNIA	VARICOCELE	CONGENITAL HYDROCELE
Occurs at all ages	Between 15 and 40 years	In infancy
Pyriform in shape	Irregular and nodular	Pyriform
Feels soft and elastic	Soft like "mass of angle worms"	Hard and elastic
Expansile impulse on coughing	No definite impulse	Usually absent, if present only slight
Not translucent in adult, rarely so in infancy	Non translucent	Translucent
No fluctuation	No fluctuation	Fluctuation can be obtained
Usually resonant on percussion if intestine is in the sac	Dull	Dull
dull with amentum alone		
Gurgling on auscultation of intestine is present	Negative	Negative
On reduction, there is a feeling of a solid nodular mass slipping away from the fingers, and a gurgle if intestine is present	Does not reduce	Fluid can be forced slowly back into abdomen without causing symptoms
May disappear entirely when patient lies down	Always disappears in recumbent posture	Does not disappear
Hernia will not reappear on assuming an upright position as long as the examiner makes pressure with his fingers over the external ring	Will reappear in spite of pressure	Reappears slowly

COMPLETE INGUINAL HERNIA	FEMORAL HERNIA
The hernia makes its exit through the external ring internal to the spine of the os pubis	The hernia is entirely external to the spine of the os pubis
A protrusion of the hernia causes a distention of the inguinal canal	The inguinal canal is empty
Reduction by taxis is upward outward and backward	Direction of reduction is upward and backward

**2 Differential Diagnosis of Complete Irreducible Inguinal Hernia**—In the male, an irreducible scrotal tumor may be a scrotal hernia, a hydrocele of the cord or of the tunica vaginalis an inflammation or newgrowth of the testis an ectopia of the testis, or a hematocele

The swelling of the hydrocele is usually sharply circumscribed from the abdomen, while in hernia it appears to be directly continuous with the abdominal wall (Figs 54 and 55) The differential diagnosis of hernia and hydrocele was fully described by Dionis in 1698, including the transillumination test with a candle

In infants, a hernia is sometimes translucent owing to the thinness of the intestinal wall This should be remembered in differentiating hydrocele and hernia in youngsters

**Acute Encysted Hydrocele of the Spermatic Cord**—Acute encysted hydrocele of the spermatic cord is sometimes mistaken for strangulated hernia, on account of the symptoms of nausea, vomiting and pain associated with a recently formed hard, tense tumor In acute encysted hydrocele, there is usually a history of trauma, followed by pain and the appearance of a tumor which is translucent The cord can often be palpated between the swelling and the external ring

**Hydrocele of a Hernial Sac**—A hydrocele of a hernial sac must some times be differentiated from a hydrocele of the tunica vaginalis. In the former there is a history of a previous reducible swelling and a fullness in the inguinal canal, the neck of the sac can be traced to the internal abdominal ring, and a portion of the tumor is often translucent. A hernia and a hydrocele of the processus vaginalis may exist in the same scrotum on the same side.



Fig. 51.—Hydrocele of the tunica vaginalis testis in a man aged fifty years.



Fig. 52.—Large tense hydrocele extending up into the inguinal canal as far as the internal ring. Unless a herniorrhaphy is done or the hernia injected at the time of the hydrocele operation patients with this type of hydrocele nearly always develop a hernia.

**Congenital Hydrocele in Children**—In children with congenital hydrocele, the fluid will disappear from the scrotum if the child is held up by the feet with his head downward.

## THE DIFFERENTIAL DIAGNOSIS OF COMPLETE IRREDUCIBLE INGUINAL HERNIA

HERNIA	HYDROCELE	INFLAMMATION, NEW GROWTH OR ECTOPIA OF TESTIS	HEMATOCELE
History of previously reducible swelling of slow growth Appearance pyriform	Always irreducible and of gradual formation Usually globular	Always irreducible and of slow formation Rounded or oval	History of onset after injury Globular, often ecchy- motic is seen soon after injury
Feels soft and semi- elastic	Tense and elastic	Firm, often irregular	Tense and elastic
Expansile impulse on coughing	No expansile impulse	No impulse	No impulse
Not translucent	Usually translucent	No translucency	No translucency
No fluctuation	Can be obtained	None unless fluid is also present	Can be obtained in most cases
Resonant on percussion if intestine is in sac	Dull	Dull	Dull
Gurgling on auscultation if intestine is present	Negative	Negative	Negative
Spermatic cord is behind and hidden by hernia	Plainly palpable above swelling	Plainly felt, vas may be enlarged and sensitive	Easily felt above tumor
Testis usually easily felt behind and below hernia	Not felt if sac is tense, can be seen by transillumination	Epididymis or body of testis can be palpated	Cannot be felt, as a rule lies below and behind

IRREDUCIBLE HERNIA	CAST	ABSCESS	FISTULOUS TUMOR	HYDROCELE OF CANAL OF NUCK
Very rare	Not uncommon	Frequent	Rare	Rare
Feels soft and semi- elastic	Tense	Tense	Soft or hard, non-elastic	Tense
Expansile impulse on cough- ing	None	None	None	None, as a rule
Not translucent	Usually trans- lucent	Not trans- lucent	Not translu- cent	Often translucent
No fluctuation	Present	Present	None	Present
Resonant on percussion if intestine is in sac	Dull	Dull	Dull	Dull
Inguinal canal distended by neck of sac	Empty	Empty	Empty	Empty

Keller reported a case that illustrates the danger in mistaking a hernia for a hydrocele. A man, aged fifty eight years, was tapped twice with a trocar and cannula and only a little blood obtained. Severe pain developed soon after, and at operation ten hours later a strangulated hernia was found with considerable hemorrhage in the sac. Death from peritonitis followed on the fourth day. I recall a patient who refused to permit a physician to tap his hernia.

**Ascites**—A sudden accumulation of ascitic fluid with an old irreducible hernia may be mistaken for a strangulated hernia. If there is dullness over the abdomen, which changes with the patient's position, paracentesis abdominis will clear up the diagnosis. The hernia symptoms often overshadow those of the ascites.

**Irreducible Hernia in the Female**—An irreducible inguinal hernia in the female must be differentiated from irreducible tumors of the labium majus,

such as a cyst, which may be glandular, a hydrocele of the canal of Nuck, abscess, and a fibrous tumor. Hydrocele of the canal of Nuck is more common in children than is generally supposed.

Sturmdorf observed the case of a woman aged thirty-four years, who had occasional attacks of pain and fullness just internal to the inner side of the right anterior superior spine of the ilium. In the last attack the symptoms simulated peritoneal suppuration with peritonitis. At operation, a strangulated properitoneal right inguinal hernia was found.

### Diagnosis of Incomplete Inguinal Hernia —

*1 Differential Diagnosis of Incomplete Reducible Inguinal Hernia*—In the male, the diagnosis of an incomplete reducible hernia is usually a simple matter. About the only condition that is liable to cause confusion is a funicular hydrocele, in which the processus vaginalis has been obliterated near the external ring but is open above, still communicating with the peritoneum. This is an uncommon variety of hydrocele and although it is reducible it is not accompanied by any other symptoms of hernia. In the female a funicular hydrocele may occur in the canal of Nuck.

Incomplete reducible inguinal hernia or bubonocoele must not be mistaken for a reducible femoral hernia. In males the diagnosis presents no difficulties but in females the examiner must be on his guard especially if the patient is obese. Small bubonocoeles can sometimes be diagnosed by having the patient strain in a standing position and then lie down. A difference in the prominence of the inguinal canal will be noticed if a bubonocoele is present.

INCOMPLETE REDUCIBLE INGUINAL HERNIA	REDUCIBLE FEMORAL HERNIA
Hernia above the inguinal ligament which can be felt below the femur.	Hernia in front of and covers inner end of the inguinal ligament.
Inguinal canal distended by the hernia. Impulse on coughing.	Inguinal canal is empty and no impulse obtained by coughing.
Direction of reduction is outward upward and backward.	Direction of reduction is downward backward and upward.

*2 Differential Diagnosis of Incomplete Irreducible Inguinal Hernia*—An incomplete inguinal hernia that is irreducible must be differentiated in the male from the following conditions: a partially descended testis; a hydrocele of the processus vaginalis of a partially descended testis; an encysted hydrocele of the cord in the inguinal canal; a dermoid cyst of the inguinal canal, a hematoma or lipoma of the cord; and malignant growth of the cord.

A partially descended testis is recognized by the shape and consistency of the tumor, and by the absence of a testis in the corresponding side of the scrotum (Fig 56). If the ectopia is complicated by a hydrocele, diagnosis will be difficult. A normally descended testis may be temporarily drawn up into the inguinal canal by the action of the cremaster muscle, this happens most often in children and a second examination is frequently required to make the diagnosis.

Encysted hydrocele of the cord is a tense fluctuating tumor, which is attached to the cord and moves with it. The hydrocele is translucent and the cord can be palpated between the external inguinal ring and the tumor.



Hematoma of the cord usually has a history of trauma with ecchymosis of the skin immediately following the injury.

A lipoma of the cord presents no symptoms except the soft fatty mass that has usually existed for a considerable length of time without tendency to increase in size.

Malignant diseases of the cord are rare. They present a characteristic hard swelling that may have followed an injury and steadily increases in size. I have seen metastasis extend along the cord into the abdomen very early in the disease.



Fig. 66.—Double undescended testes in a boy aged twelve years. On the right side the testicle is just below the external ring (subcristally); on the left side it is in the inguinal canal near the internal ring (inguinal crypty).

In the female an incomplete irreducible inguinal hernia must be differentiated from the following conditions: hydrocele of the canal of Nuck, lipoma and other tumors of the round ligament and dermoid cyst in the inguinal canal.

Hydrocele of the canal of Nuck is a tense fluctuating tumor which cannot be forced out of the inguinal canal. If it is large it may be translucent.

**In Both Sexes**—Incomplete irreducible inguinal hernia is to be differentiated from the following conditions that affect both sexes: inguinal adenitis, abscess in the inguinal region, psoas abscess, exostosis of the os pubis, aneurysm, lymphogranulomatosis, and in tropical regions, climatic bubo.

Inguinal adenitis presents an indefinite swelling, which is tender, painful, and often freely movable under the skin. Examination will show that the

inguinal canal is empty and has no connection with the enlarged lymphatic gland. Other adjacent glands are often enlarged from the same source of infection. It should be remembered that in rare instances an abscess develops over the hernial sac. If this complication is suspected, great care should be taken not to wound the sac.

A psoas abscess may come to the surface above the inguinal ligament. It will present a reducible swelling that is dull on percussion, and gives a slight impulse on coughing. Examination of the spine will disclose the source of the abscess.

Inguinal aneurysm is very rare, but always to be thought of when examining an obscure hernia.

Lymphogranulomatosis is due to an ameba, and disappears when emetin is given. Climatic hilio is due to an ameba or filaria, and responds to appropriate treatment.

### PROGNOSIS

The prognosis of inguinal hernia depends on the age of the patient, the size of the hernia, and the condition of the sac contents.

**Infants and Children**—In infants and children under three years old, small hernias can often be cured in a few months by a truss. After the age of four years, cure by a truss is comparatively rare, and operative treatment is to be advised. Operation is also indicated in large or uncontrollable hernias in both infants and children.

The annoyance of the truss often makes these little patients nervous and irritable, backward in school work, and unable to participate in games with other children. While the danger of strangulation in young children is slight, it increases as the child grows older.

**Uses and Limitations of the Truss in Adults**—Small hernias can sometimes be controlled with a truss. For those patients who refuse operation, palliative treatment is necessary to keep the hernia from becoming large and uncontrollable.

Every patient who wears a truss and believes it is properly fitted, knows that it is only a makeshift, that it will not cure his hernia, and that there is danger of strangulation at any time should the truss slip while he is engaged in active exercise. He also knows that if his hernia increases in size, as many do, he will have to seek further treatment, and it is at this stage that many patients become easy prey for the charlatan or quack.

The irritation, annoyance and physical discomfort caused by the truss are very pronounced, especially during the summer months and at times are sufficiently serious to impair the health. Patients often remark that they were unable to do a full day's work until the hernia was cured by the injection treatment or operation. A number of patients supposed to have been cured by a truss in infancy, have a return of their trouble in adolescence or early manhood. If the pressure of the truss has been firm, peritoneal adhesions form and a gradual decrease in the size of the abdominal opening usually results.

**Radical Operation**—Patients with simple reducible hernia often seek operation in order to be relieved of the discomfort and annoyance of the truss. The French term these cases "*operations de complaisance*"

Operation is to be recommended for every adult with hernia unless there are definite contraindications, such as advanced age, shock, hemorrhage, cardiovascular, nephritic or pulmonary lesions. Even these conditions that preclude general anesthesia are no barrier to operation if local anesthesia is used. I have employed it successfully in nonstrangulated hernia in patients from five to eighty five years old.

The radical operation carries only a slight risk, while complications average about 10 per cent, most of them are of a minor nature since postoperative treatment is being steadily improved. Ramos and Burton reported 4 deaths in 868 patients, a mortality of 0.46 per cent in simple nonstrangulated hernia with spinal anesthesia.

To those patients in the advanced years of life, surgical procedures carry a multitude of dangers, the principal ones being the general anesthetic and respiratory complications. For this reason, elderly patients should be out of bed the day following operation.

**Anesthesia**—Local anesthesia is the anesthetic of choice for nonstrangulated hernia in both children and adults. The operation can be done more thoroughly than with general anesthesia, because there is no need for haste, with the patient awake and comfortable. And to digress for a moment—the patient is comfortable and free from pain at all times during the operation if the operator is skilled in using local and spinal anesthesia.

With local anesthesia there is no postoperative vomiting and straining to loosen the sutures. Complications, such as pneumonia, nephritis, shock, cardiac failure and acute dilation of the stomach are eliminated, with the result that there is practically no mortality. Many patients will consent to operation under local or spinal anesthesia whose hernias would be forever neglected if the operation involved a general anesthetic, especially those who, at some time, have had a stormy and protracted convalescence after general anesthesia.

However, the local method is usually contraindicated in the patient who does not want it, who prefers for any reason to be asleep during the operation. It is often a mistake to urge local anesthesia on the skeptical and, as a rule, I administer a general anesthetic to this type of patient provided, of course that he is in every way a suitable risk for it.

**Strangulation**—Strangulation is the greatest danger that confronts the hernia patient. It usually occurs when least expected, and the mortality following the emergency operation is high. To my mind this is the most important reason for making operation for all nonstrangulated inguinal hernias. In 1,429 operations for strangulated hernia collected by Sultan the mortality was 20.7 per cent.

The percentage of strangulation is highest in those patients whose hernias have been retained by a truss for a number of years, and have then suddenly come down. Most often the hernia accidentally slips by the truss during

straining or exertion, but every once in a while a patient will turn up, who, imagining himself cured, discarded his truss and the hernia unexpectedly recurred and strangulated. The point of constriction is usually the internal ring, rarely the external ring, both have become narrowed while the hernia was being retained by the truss. In patients who have never worn a truss, the rings are widely dilated and strangulation is not frequent.

**Local Anesthesia in Strangulated Hernia**—The importance of local anesthesia in strangulation cannot be overemphasized. Its use will do more than anything else to reduce the mortality in these cases in which shock and lowered vitality too often exact their toll. The local method provides ample time to determine the viability of the intestine and if resection is necessary it can be done without additional risk to the patient.

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## CHAPTER XIV

### LOCAL AND SPINAL ANESTHESIA

**Spinal Anesthesia**—Spinal anesthesia is generally used for hernia operations in the good-risk patient. The anesthetic in experienced hands is quickly induced, is safe for the patient, and gives a maximum amount of relaxation. General narcosis leaves much to be desired on account of the danger of post-operative complications.

**Local Anesthesia**—In selecting the anesthetic for a hernia operation, the life of the patient is always the first consideration, a fact that is sometimes lost sight of by those who condemn the local method, because it takes too much time. While anesthesia by the infiltration method usually requires more time than general anesthesia, this is not true of the regional method. With regional anesthesia the field of operation can be completely blocked in less time than it takes to secure surgical analgesia with general anesthesia. Reclus remarked that the operation for hernia is the triumph of local anesthesia.

It is indicated for nonstrangulated and strangulated inguinal and femoral hernias, and for a majority of the umbilical and ventral varieties.

Local anesthesia adds greatly to the comfort and safety of the young and robust, and when the patient is handicapped by old age, shock, hemorrhage, pulmonary nephritis or cardiac lesions, the local method is especially indicated, if he is to be given the greatest chance for recovery. Local anesthesia removes the danger from either pneumonia and renal insufficiency. I recall the case of a young man, twenty-five years old, who developed anuria following an ether anesthesia for a small inguinal bubonocoele. The operation lasted only one-half hour. The first twenty-four hours he passed three ounces of bloody urine, one ounce the second day, and he died on the third day.

**Advantages of Local Anesthesia**—Every step in the operation that is carried out under general narcosis can be done with local anesthesia. In strangulation with the accompanying lowered vitality, local anesthesia is a safeguard against shock, and it also provides ample time to determine the viability of the intestine, and if resection is necessary, it can be done without additional risk to the patient. (Fig 57.)

Extreme old age, organic disease of the cardiovascular system, lungs or kidneys were formerly believed to be contraindications to the radical operation for nonstrangulated hernia. With a good technique, there is practically no contraindication to the cure of every hernia, regardless of the age of the patient. Glenn has recently reported 1,090 hernia operations with local anesthesia, at the New York Hospital. Hermal has performed 3,400 hernia operations under the local method.

**Contraindications**—To my mind there is only one contraindication to the use of local anesthesia in nonstrangulated hernia, and that is the case of the

patient who does not want it, who for any reason prefers to be asleep during the operation. It is often a mistake to urge local anesthesia on the skeptical, and, as a rule, I administer a general anesthetic to this type of patient, provided, of course, that he is in every way a suitable risk for it.

Local anesthesia is usually contraindicated in children and neurotic subjects when the hernia is not strangulated. However, there are exceptions to this rule. I recall the case of a boy, five years old, with a right inguinal hernia, whose parents insisted on local anesthesia because another member of the family had recently succumbed to an ether anesthetic for a simple hernia operation. The little patient did not complain of pain at any time, although it was hard to keep him still, as he insisted on getting down on the floor and playing with his toys. Lee has reported a successful operation for strangulated hernia under local anesthesia in an infant, twenty days old.

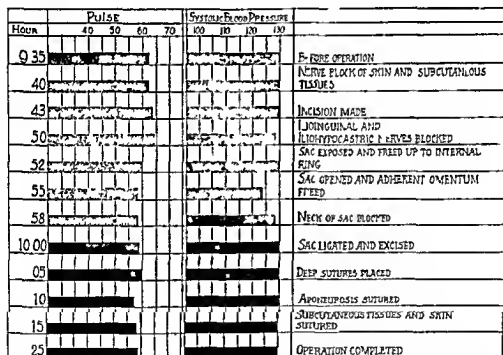


Fig 57—Pulse and systolic blood pressure chart. Inguinal hernia operation under local anesthesia. No morphine. Mr. D. (Case 186), aged thirty years. Throughout the operation there was little change in the pulse or systolic blood pressure.

**Methods of Inducing Local Anesthesia**—Local anesthesia is the anesthetic of choice for many hernia operations. There are three principal methods of inducing it: infiltration, regional or block, and paravertebral anesthesia.

**1 Infiltration Anesthesia**—Infiltration anesthesia is the most popular method of local anesthesia. It is simple, easily accomplished, and its only drawback is that it takes more time than the regional method.

**2 Regional Anesthesia**—Regional or block anesthesia for the inguinal hernia operation is carried out as follows. A point is selected two-finger-

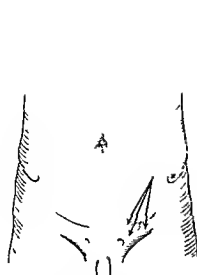


Fig 58

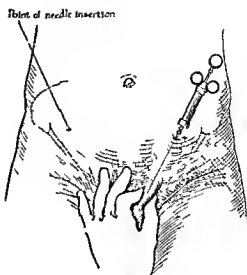


Fig 59

Fig 58—Regional anesthesia. The lateral arrows indicate the subaponeurotic injections to the inner and outer side of the internal ring. The central arrow is the injection to block the cord structures.

Fig 59—Regional anesthesia. A long needle is passed down through the subcutaneous tissue to a point below the external ring and the cord injected while it is held up between the thumb and the forefinger.

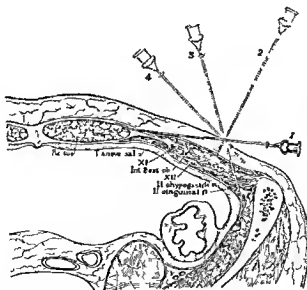


Fig 60—Regional anesthesia. Cross section showing the blocking of the last two dorsal and the iliohypogastric and ilioinguinal nerves.

breadths or 1 inch (2.5 cm) internal and just below the anterior superior spine of the ilium and a wheal is made in the skin as described under infiltration anesthesia. A fine needle 4 inches (10 cm) long is now attached to the syringe and introduced through the anesthetized area and a number of injections made at different points on a line between the umbilicus and the anterior superior spine. The injecting needle passes through the aponeurosis, the external oblique, the internal oblique and the transversalis muscles. The first two or three injections are made toward the umbilicus to block the last two dorsal nerves and succeeding injections are in the direction of the spine of the ilium to block the iliohypogastric and ilioinguinal nerves. An injection is next made beneath the aponeurosis just to the outer side of the internal ring and a second one just to the inner side. This gives a fan shaped area of nerve block. To block the cord below the external ring the long needle is partially withdrawn and passed down through the subcutaneous tissues to a point below the external ring and the cord injected while it is held up between the thumb and the forefinger. (Ligs 58-60)

**3 Paravertebral Anesthesia**—Paravertebral anesthesia for the inguinal hernia operation is accomplished by blocking the last three intercostal nerves and the first four lumbar nerves close to their exits from the vertebral column. Because of the difficulties of paravertebral anesthesia, the infiltration or regional methods are to be preferred in the ordinary hernia operation.

**Advantages of Spinal Anesthesia**—Spinal anesthesia is very popular and satisfactory for hernia operations because of the complete relaxation and the absence of retching and vomiting that sometimes follow general anesthesia. Procaine in high concentration to obtain paralysis will usually be sufficient. However for difficult and bilateral operations it is advisable to use the more lasting anesthesia afforded by metacaine or pontocaine.

It is advisable to give 50 mg of ephedrine sulphate intramuscularly before spinal injection to prevent a fall in blood pressure. For detailed technique see Babcock, Lundy and Delorme.

**Contraindications**—Spinal anesthesia is usually contraindicated when the systolic blood pressure is very high or below 120 mm in strangulated hernia when the patient is gravely ill with gastrointestinal perforation when complicated by intestinal obstruction in the presence of peritonitis in case of cerebrospinal disease, with dorsal skin infection and drug idiosyncrasy.

On account of the marked relaxation with spinal anesthesia the deep sutures should not be tied under tension as is customary with general narcosis.

**Neurologic Complications Following Spinal Anesthesia**—Complications following the administration of spinal anesthesia are rare but they do occur and may be as follows: failure of the patient to regain the use of his lower extremities at the usual time, urinary retention, incontinence of feces, loss of motor and sensory function and long continued headache. Wakeley observed permanent bilateral paralysis after spinal anesthesia. Nicholson and Eversole of the Lahey clinic have dealt with these complications at length.



### Anesthetic Agents

**1 Procaine Hydrochloride (Novocaine Neocaine)**—Procaine is the most generally used local anesthetic. It is about one seventh as toxic as cocaine and a relatively large amount of a 0.2 per cent solution can be injected without danger of toxic symptoms.

*a Local*—One half per cent solution is used for the skin and nerve trunks and 0.2 per cent solution elsewhere. It is necessary to add 2 minims (0.12 cc) of epinephrine solution (1:1000) to each ounce (30 cc) of the novocaine solution. The procaine must be sterile and dissolved in sterile normal salt solution or Ringer's solution. The anesthetic solution must be freshly prepared for each operation and always of a definite strength so that the operator may know at any time the exact amount of drug that has been used.

*b Spinal*—It is best to use 1 mg. of procaine per pound of body weight up to 150 mg. for an adult. Dissolve 150 mg. of procaine hydrochloride in 3 or 4 cc of spinal fluid withdrawn through a 22 gauge needle at the third or fourth lumbar interspace. After the anesthetic is completely dissolved slowly reinject the solution.

Procaine is a popular spinal anesthetic. It is milder than the others and the action is of shorter duration, about one to two hours.

**2 Pontocaine Hydrochloride (tetracaine)**—This is one of the safest spinal anesthetics and is widely employed by surgeons. It is less depressing than procaine or metycaine.

*a Local*—A 0.1 per cent solution is satisfactory for local infiltration.

*b Spinal*—For hernia operations 1.2 to 1.5 cc of 1 per cent pontocaine solution is mixed with 2.5 cc of a 10 per cent dextrose solution. The dextrose makes the solution heavier than the spinal fluid. The anesthesia lasts one to three hours.

**3 Metycaine**—Metycaine is about three times as toxic as procaine. Its action is more rapid and the anesthesia lasts longer.

*a Local*—For local anesthesia a 0.5 to 1.0 per cent solution is employed.

*b Spinal*—Spinal anesthesia is usually induced by dissolving 100 mg. of metycaine in 3 or 4 cc of spinal fluid and slowly reinjecting the solution.

**4 Nupercaine Hydrochloride (percaine)**—Nupercaine hydrochloride is approximately twenty times stronger than procaine and is usually reserved for very long operations.

*a Local*—For infiltration anesthesia a 0.1 per cent solution is satisfactory and affords prompt anesthesia.

*b Spinal*—The usual dosage for spinal anesthesia is 10 cc of a 20 cc ampule which contains a 1:1500 dilution of nupercaine in 0.5 per cent solution of sodium chloride.

Nupercaine is indicated when the operation will be prolonged as the anesthesia lasts for several hours.

**5 Intracaine**—Intracaine is twice as toxic as procaine and gives a longer anesthesia than procaine. McCuskey has reported 2500 anesthetics with intracaine without untoward effects.

*a Local*—For local anesthesia a 0.5 to 0.1 per cent solution is effective

*b Spinal*—For spinal anesthesia 25 to 50 mg dissolved in 3 to 4 cc of spinal fluid is given. The anesthesia lasts for two to three hours.

**6 Butyn**—Butyn is one of the best of the local anesthetics, and is especially adapted to hernia operations because the anesthesia appears immediately after the solution is injected—quite an important point for the busy surgeon. Butyn is about one third as toxic as cocaine and is nonirritating to the tissues. It should be dissolved in sterile water, 2 minims (0.12 cc) of epinephrine added, and then boiled for two minutes. This boiling causes a slight cloudiness that disappears after the solution has stood a while. One fifth per cent solution is sufficient for hernia operations and the anesthesia will last for an hour or an hour and a half. Butyn is too strong for spinal anesthesia.

**Preparation of the Local Anesthetic Solution**—The anesthetic solutions should be freshly prepared for each operation, and distilled water should always be used in making them. A simple plan is to dissolve the anesthetic substance in a small amount of distilled water in a test tube, boil for three minutes and then add the solution to the proper amount of distilled water, sterile normal salt solution or Ringer's solution. To prepare a 0.1 per cent solution, dissolve 1 grain (0.065 Gm) in 2 ounces (60 cc) of solution, for a 0.2 per cent solution add 1 grain to 1 ounce (30 cc) and to make a 1 per cent solution dissolve 5 grains (0.265 Gm) in 1 ounce (30 cc) of solution.

**To Prolong the Anesthesia**—The ordinary anesthetics do not give an analgesia that lasts long enough for the average hernia operation, and it is necessary to add a substance to prolong the anesthesia period. I usually use calcium chloride for this purpose as there is no danger of its causing necrosis in the wound, as epinephrine sometimes does if it is used in too concentrated solution, especially in aged patients or in the obese.

**1 Epinephrine**—Epinephrine (adrenalin suprarenin), is added in the proportion of 2 minims (0.12 cc) to each ounce (30 cc) of the anesthetic solution, so that the analgesia, instead of lasting only five to twenty minutes, will persist for thirty to sixty minutes depending on the anesthetic selected and the strength of the solution, and there is ample time to complete the ordinary hernia operation before sensation returns.

Other drugs that are sometimes used in conjunction with epinephrine to prolong anesthesia are chlorobutanol, potassium sulphate and calcium chloride.

**2 Chlorobutanol**—Chlorobutanol is soluble in water, 8 parts in 1,000. It intensifies the anesthesia and is an excellent antiseptic when it is necessary to prepare the solution some time before it is to be used. Chlorobutanol is decomposed by boiling, therefore it should not be added until the solution has cooled.

**3 Potassium Sulphate**—Potassium sulphate, 0.25 per cent solution, is valuable to intensify and prolong the anesthesia. Hoffmann and Kochmann stated that it increases the anesthetic effect 100 per cent.

**4 Calcium Chloride**—Calcium chloride also intensifies the anesthesia. It is used in 0.25 per cent solution. Harris advocated adding both potassium sulphate

(0.25 per cent) and calcium chlorid (0.2 per cent) to the novocaine or apothecin solution and finally adding the epinephrine

**Toxicity of Local Anesthetics**—All local anesthetics are toxic if a sufficient amount is injected. Several factors govern the toxicity, namely, the age and general health of the patient, his personal idiosyncrasy, the concentration of the solution, the rapidity of the injection and the kind of tissue injected. The more vascular the tissue the quicker the absorption. Accidental injection into a blood vessel may result fatally. This accident should never occur if the following precautions are observed: the operator should always know the exact location of the point of the needle; only a small amount of the solution should be injected at one time; the injection should be made slowly and the needle kept moving while infiltrating the tissues.



Fig. 61A.—A 10 c.c. or mill glass hypodermic syringe

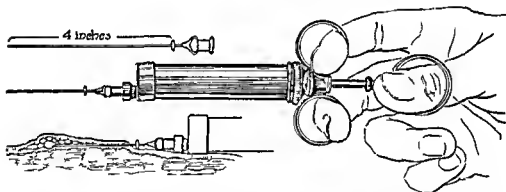


Fig. 61B.—The author's all metal hypodermic syringe for local anesthesia. The syringe holds 4 ounces (7.5 c.c. or mills). It has comfortable ring finger rests, an eccentric tip to facilitate skin infiltration and the Luer needle lock to prevent the needle from flying off when injecting the anesthetic solution under pressure. The ordinary Luer slip needle can also be used.

**Syringes**—Different operators prefer various syringes. In an emergency the ordinary 30 minim (2 c.c.) pocket hypodermic syringe can be used. A 5 to 20 c.c. syringe is the best as it saves the time required for the frequent refilling of a smaller syringe (Fig. 61A).

The syringe should take a slip needle (Luer or Record) to facilitate rapid refilling. The infiltration of the skin and nerve sheaths is easy if the syringe has an eccentric tip so that the needle is on a line with the lower part of the body of the syringe (Fig. 61B).

**Needles**—The needles should be of small caliber from 1 to 2 inches (2.5 to 5 cm.) in length and should always be kept sharp and clean. A longer needle is seldom required except for blocking the deep nerves before incising

the skin as required in the regional method for the inguinal hernia operation. The finest needle should always be selected for the initial skin wheal.

**Technique of the Injection**—The anesthetic solution should be freshly prepared and is least irritating when it is injected at body temperature. The physician who would use local anesthesia should remember that the successful operation is painless. Patients frequently fall asleep during the latter part of a tedious hernia operation especially after the peritoneum has been closed.

Success depends upon patience, an intimate knowledge of the sensory nerve distribution and special training in the method. The technique of the injection is always delicate; it varies in each patient, in each operation and in each region. The rapidity, intensity and duration of anesthesia depend on the anesthetic and the strength of the solution. The surgeon must not begin the operation until anesthesia is complete, usually five to ten minutes after injection. He must always be careful to keep well within the zone of anesthesia. Beginning the operation before anesthesia is complete and carelessly cutting into unanesthetized tissues will quickly destroy the patient's confidence and once it is lost, it cannot easily be regained. The patient should be told that the anesthetized area will feel numb and while he can hear the moving of the instruments and feel some pulling of the tissues there will be no pain.

As Smith has remarked there is no legerdemain in local anesthesia; it is simply a question of mastering the technique. When the patient becomes restless and complains of a vague general pain in the wound during a tedious operation it usually means that skin sensation is returning. It is a simple matter to reinject the skin wound and the patient is soon comfortable again.

In blocking the ilioinguinal and iliohypogastric nerves the anesthetic is injected into the nerve sheath and not directly into the nerve itself. (The detailed technique of the infiltration is fully described step by step in the chapter on the operation for inguinal hernia.)

**Preoperative Treatment**—When indicated young and middle aged patients with nonstrangulated hernia receive a sedative one hour before operation to allay any restlessness or nervousness.

**Delayed Wound Healing**—Sloughing after local anesthesia is due to too extensive edematization of the tissues, the use of nonsterile or nonisotonic solutions or to too much epinephrine in the anesthetic solution. When sloughing occurs it is nearly always in aged patients in whom the tissues are of low vitality. In these subjects the anesthetic solution should be injected carefully so that every drop counts and if just enough is used to secure anesthesia and unnecessary infiltration of distant tissues avoided there will be no sloughing. In several hundred hernia operations under local anesthesia I have never seen sloughing of the wound.

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## CHAPTER XV

### DEVELOPMENT OF THE MODERN OPERATION FOR HERNIA

The literature on the history of the treatment of inguinal hernia is so extensive that only the important points can be discussed here (See Chapter I)

I believe a brief historical review of the evolution of the present day operation for inguinal hernia might be of much interest pointing out the technical means whereby the author hoped to lessen a recurrence rate that has remained too high in direct and indirect inguinal hernia. Spree does not permit the description of the hundreds of minor variations in technique that have been published. Some of these procedures were without merit and others were discarded because they were too complicated. At the present time surgeons are continually reviving old methods thinking they have discovered something new when if they would look up the literature they might find their theories have been tried out and discarded long ago.

**Marcy's Operation**—Marcy in 1881 was the first to advocate high ligation of the sac, transplantation of the cord and reconstruction of the inguinal canal as they are practiced today. He freed the sac to a point within the internal ring and drew it firmly downward so as to make the parts tense. It was then sewed across the neck with a continuous double suture of fine kangaroo tendon and the sac was excised. The stump of the sac was carried within the internal ring and the cord lifted up and retracted toward the median line. A full curved needle threaded with kangaroo tendon was passed through the posterior edge of Poupart's ligament on the outer side and carried inward and emerged from behind forward through the thick aponeurosis of the fascia transversalis. The sutures were placed about one third of an inch (8 mm) apart and the internal ring was closed from below upward until the cord was restored to its original point of exit from the abdomen. Before suturing the conjoint tendon to Poupart's ligament in large hernias approaching the direct variety Marcy introduced several stitches through the peritoneum, fascia and muscles to strengthen the structures that form the floor of the canal and to restore its obliquity. Having thus reconstructed the posterior wall the cord was replaced.

A needle threaded with kangaroo tendon was passed from without inward through Poupart's ligament at a level with the reformed internal ring and carried through the firm muscular and tendinous structures on the inner side of the canal. These stitches were continued downward and inward over the cord until the external ring was restored to its normal size. The skin was closed by a buried continuous suture. Marcy did not use drainage and he was the first to use absorbable sutures in hernia operations.

**Bassini's Operation**—In 1893 Bassini attempted to cure inguinal hernia by ligating the sac at the internal ring stitching the stump to the posterior surface of the external oblique and using a portion of the neck of the sac as a tampon to close the inguinal canal finally bringing the edges of the aponeurosis together and closing the skin. He soon realized that this method had the same fault as the operations described by Wood and Czerny—that recurrence took place unless the patient wore a truss after operation—so he abandoned it and adopted the operation described by Marcy (see Chapter I)

The principal features of the Bassini operation are high dissection of the sac transplantation of the cord and repair of the posterior wall of the inguinal canal to restore its obliquity. Silk was used for all sutures. The edges of the aponeurosis were only approximated. The patient was placed in a plaster of Paris cast and kept in bed for six weeks. In 1889 Bassini reported 262 operations by this method.

**Halsted's Operation**—In 1889 Halsted suggested suturing the conjoint tendon and fascia to the internal oblique muscle cremaster muscle and fascia with mattress sutures. The cord is not disturbed.

**Lotheissen's Operation**—In 1898 Lotheissen published his observations on suturing the transversalis fascia to Cooper's ligament. Lotheissen believed the operation was most suitable for femoral hernia operations and did not stress its value for inguinal hernia repair. The modern Cooper's ligament operation is the development of the pioneer work of Lotheissen.

It must be pointed out that many of the more recent hernia operations that have been described in the literature are very ingenious and are invaluable to meet special situations in the repair of difficult hernias.

### Historical Summary

The historical summary has been compiled especially for the student interested in the development of hernia surgery.

Probably 90 per cent of the operations are modifications of the Bassini Halsted or Lotheissen operations. Often the surgeon has employed the procedure for some time before the publication of his paper. Also, when a name appears more than once it usually indicates that the surgeon has changed his operative procedure. The operations are most conveniently grouped by the author and year of publication.

**Methods That Do Not Free the Sac**—These early operations represent perhaps the first efforts to correct a hernia. They are only of historic interest. Paget (1872), Bouehut (1877), Czerny (1877), Buchanan (1879), Bryant (1882), Stokes (1884), Erichsen (1885), Franks (1887), Socin (1888), Terrillon (1889), Bottini (1891), Goodwin (1894).

**Methods That Leave the Sac in the Inguinal as a Pad to Close the Opening**—These operations are no longer used and date from the early days of hernia surgery when it was believed that anything that plugged the canal would cure the hernia. Reisel (1877), Macewen (1879), Bassini (1883), Ball (1884).

Molliere (1888), Leonté (1888), Wolfer (1892), Kocher (1892), Roux (1894), Fauro (1898), Petralis (1903), Elkourie (1912), Pond (1914), Sellings (1915), Friend (1919), Frank (1922)

**Methods That Close the Wound With Wire Staples, Nails, Wire or Silk Filigree**—Heteroplastic operations are seldom used at the present day. Some of the more popular were Witzel (1890), Phelps (1894), Harris (1900), Meyer (1902), Bartlett (1903), Nicoll (1907), McGavin (1909), Nota (1914), Handley (1918), Bennett (1918), Koontz (1926), Thomas (1934), Michael (1937), Cole (1941), and Mangot (1941)

**Methods That Free the Sac and Suture the Aponeurosis of the External Oblique Without Disturbing the Inguinal Canal**—Another group of early hernia operations that date from an early period when the surgeon was afraid to open the inguinal canal and suture it. Reverdin (1881), Lucas Championniere (1881), Banks (1882), Félizet (1890), Launderer (1891), Kocher (1892), Le Deutu (1900), Estor (1903), Mermingas (1920)

**Methods That Fix the Stump of the Sac to the Internal Abdominal Wall**—These operations were also devised under the mistaken notion that a plug behind the internal inguinal ring was the secret of curing hernia. Barker (1884), Bishop (1890), Kingscote (1890), Bennett (1891), Baxter (1893), Phelps (1894), Lever (1911), Hayner (1932)

**Methods That Use a Periosteal Flap or Bone Transplant**—These operations are only of historic interest and are no longer used in hernia surgery. Kraske (1890), Trendelenburg (1890), Thurner (1893), Pouliet (1894), Lenormant (1912), Mantelli (1914), Veal and Blake (1938)

**Methods That Use a Myoplastic Operation to Close the Hernial Wound**—These operations are rarely used except to reinforce the inguinal ligament operation or the Cooper's ligament operation. Bloodgood (1892), Wolfer (1892), Schwartz, E (1893), Lusk (1900), Blake (1900), Streissler (1909), Polya (1913), Mantelli (1914), Twyman (1918), MacKenzie (1924), Rosenblatt (1930), Landivar (1941), Leon Iparraguirre (1941)

**Methods That Employ a Median, Transverse, or Cosmetic Laparotomy Incision**—These procedures are not in general use since the inguinal incision gives a better exposure of the field of operation. The cosmetic incision may be indicated in dancers or women. Annandale (1876), Tait (1883), Dalla Rosa (1900), Morestin (1903), Edmunds (1908), Lucid (1908), Judd (1913), Bates (1913), Winter (1918), La Roque (1919), Cheatle (1921), Banerjee (1932), Henry (1936), Minty and Minty (1945)

**Methods That Excise the Sac and Suture the Inguinal Canal**—These operations are most generally employed by surgeons at the present time. Marcy (1870), McGill (1883), Rabaghata (1884), Bassini (1888), Trelat (1888), Halsted (1889), Minguet (1891), Postempski (1891), Ruggi (1892), Bull and Coley (1892), Wolfer (1892), Parona (1892), Dallas (1894), Chiene (1894), Aguilar (1895), Andrews E W (1895), Gutiérrez (1895), Ferrari (1895), Fowler (1897), DeGarmo (1897), Swift (1897), Deaver (1898), Brenner (1898), Bloodgood (1898), Lambert (1898), Girard (1898), Slajmer (1898),



Lotheissen (1898) Bevan (1899) Tetanus (1899) Blake (1900), Journal (1900), Keen (1900), Bacon (1901) Leiger (1902) Millot (1902) Reclus (1902), Begoun (1903) Snodder (1903) Scott (1903) Davis G G (1906) Barra (1906) Torl (1906) Wullstein (1906) White J M (1906) Connell (1908), Dunning (1909) Kelly (1909) Schuchardt (1910) Downes (1911) Hognet (1911), Hull (1913), Newman (1914) Noetzel (1914) O Conor (1914), Sonbeyan (1915) Watson (1916) Imochetto and Squerra (1917) Lusk (1917) Slattery (1917) Hotchkiss (1918) Kirby (1918) Payne (1918) Chatterjee (1919) Lobes (1919) Torck (1919) White J N (1919) Warhase (1919) Lyle (1920) Schley (1920) Stetten (1920) Taylor (1920) Woolsey (1920) Pitzman (1921) Weichus (1921) Hesser (1922) Neuffer (1922) Schwartz J (1922) Stillern (1922) Stein (1923) Villandre (1924) Andrews I (1924) Goldenberg (1924) Bibood (1927) Cowell (1927) Schmeiden (1931) Hutchins (1932) Turner (1933) Marmings (1936) Ogilvie (1936) Scarba (1936) Benmosche (1938) Cima (1938) Pobins (1938) Wolfe (1938) Zimmerman (1938) MeVay (1939) Rienhoff (1940) McCloskey and Ichman (1940) Stein (1940) Catterina (1941) Perez Montana (1941) Neuhof (1942) Best (1942) Harkins and Swenson (1943) Collins (1942) Mastin (1942) McMillan (1942) dell Oro (1942) Tanner (1942) Komura (1943) Edwards (1943) Brimlou (1943) Ivie (1945)

**Methods That Close the Inguinal Canal With Cutis Grafts**—This method is valuable for large hernias when it is difficult or impossible to bring the edges of the hernial wound together Hawley (1889) Rehn (1924) Uihlein (1939) Swenson and Harkins (1943) Canaday (1943) Singleton and Stehnow (1945) Mau (1945)

**Methods That Use Fascia Sutures or Transplants**—Liscia sutures were first used by McArthur revised by Kirschner and popularized by Galie and Le Mesurier Fascia operations are popular and efficient but I believe that the same results can be secured with silk or cotton sutures McArthur (1901) Kirschner (1909) Macenzie (1910) Hognet (1911) Mann (1914) Hume (1915) Galie and Le Mesurier (1921) Fair (1922) Wamschenker (1923) Adair (1924) Eastman (1924) McLachern (1924) Koontz (1926) Hras (1931) Turner (1933) Wangenstein (1934) Eliot (1935) MacIrd (1936) Collins D C (1938) Hernandez de Costa (1939) Agunre (1939) Vonoehuklin (1940) Joyce (1940) Gould (1940) Estes (1941) Williamson (1941) Miranda Matus (1942) Behrend (1943) Soffel (1943) Ryan (1943) Viallobas Rojas (1944) Zingari Latorre (1944) Chiles and Fenhardt (1944) Minty and Minty (1945)

## CHAPTER XVI

### THE OPERATIONS FOR INGUINAL HERNIA

There are a number of excellent operations for inguinal hernia that have been developed to meet special situations or conditions. Most of these are mentioned in Chapter XX.

The procedures described here are popular and applicable to any type of hernia. I believe it would only confuse the reader to discuss others which are not in general use.

**Herniotomy, Herniorrhaphy, and Hernioplasty**—McKechnie has called attention to the fact that the word herniotomy is used incorrectly in describing the modern hernia operation. It is a term left over from earlier days and originally used for cutting the sac or the constricting ring of a strangulated hernia with no attempt at repair of the hernial defect. He states that herniorrhaphy and hernioplasty are more correct terms as applied to the modern operations for hernia.

#### THE COOPER'S LIGAMENT OPERATION

This operation has shown a lower percentage of recurrences than the inguinal ligament operation (Bassini) and is steadily supplanting the latter in popular favor among surgeons although the Bassini procedure presents fewer technical difficulties.

Narath is believed to be the first to have sutured the internal oblique and transversalis fascia to Cooper's ligament. Lotheissen in 1898 published the general details of the operation. He thought the method best adapted to the femoral hernia region and did not realize its full value for inguinal hernia.

It remained for Babcock to recognize the many advantages of suturing the fascia to Cooper's ligament. After using the operation for some time he published his technique and results in 1927 and called attention to the fact that the suture to Cooper's ligament closed the area of greatest weakness, the lower inner angle and the site of most recurrences.

Anson and McVay in 1938 published their studies on the subject along with the operative results secured by McVay.

This operation preserves the normal unimpeded action of the fascia and muscles of the inguinal region. We now know that the Bassini operation interferes with the normal movement and thus weakens the lower abdominal wall and favors rather than prevents recurrence. Since the lower fibers of the transversalis and internal oblique fascia are normally attached to the fibrous covering of the pubic bone, the ligamentum pubicum superius (Cooper's ligament) and not to the inguinal ligament, it is logical to adopt the suggestion of Babcock and to suture the inferior aponeuroses of the internal oblique and transversalis to Cooper's ligament.

It is generally recognized that the Cooper's ligament operation is more correct from an anatomical and physiological standpoint. Ordinarily, when *transversalis fascia* is sutured to the inguinal ligament a pool or gap is left

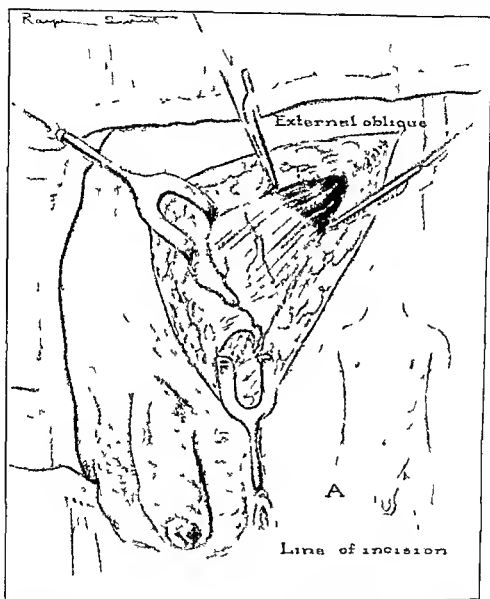


Fig. 62—Cooper's ligament operation. The skin incision is made parallel with the inguinal ligament and about  $\frac{1}{2}$  inch (1.25 cm.) above it. The incision extends lower than the Bassini operation incision.

This becomes a potential recurrent hernia often before the patient leaves the operating table. There are many modifications of the Cooper's ligament operation. Most of these procedures use Cooper's ligament sutures along with the Bassini operation.

Berne, Harkins and Swenson Morrison Neuhoef, Varela Zequeira Zimmerman and many others have called attention to the advantages of the Cooper's ligament operation

The reluctance of some surgeons to adopt the Cooper's ligament operation is due in part to their unfortunate experiences with nonabsorbable suture material, or to attempts to use it freely as if it were absorbable catgut. This operation is best carried out with silk or cotton sutures and this involves a special technique. The smallest size material is to be preferred. stitches should not be too close together. continuous sutures are never employed, all ties and knots should be cut short so as to leave a minimum amount of nonabsorbable material in the wound, and ligatures should be used sparingly.

**Skin Incision.**—A straight incision is made nearly parallel with the inguinal ligament and  $1\frac{1}{2}$  inch (125 cm) above it extending from the internal ring to the lower part of the center of the external ring and in large hernias to the center of the upper part of the scrotum just below the external ring. This incision should be 2 to 3 inches (5 to 7.5 cm) long in children and 3 to 4 inches (7.5 to 10 cm) long in adults. (Fig. 62.)

On deepening the incision the superficial epigastric and superficial circumflex iliac veins are seen crossing the field. These veins should be picked up and divided between hemostats. Some operators prefer to ligate them at once with fine silk or cotton. I do not like to leave ligatures in the fat. I prefer to let the forceps remain until the operation is finished when they can be removed without causing further bleeding provided the wound is not roughly wiped out with gauze and the terminal clots are not loosened.

To expose Cooper's ligament properly the incision must extend considerably lower than with the inguinal ligament (Bassini) operation. It should curve downward onto the upper part of the scrotum.

**Aponeurosis of External Oblique.**—After freely exposing the aponeurosis the external ring should be located. If it cannot be seen it can be found by palpating the cord where it crosses the pubic bone as it leaves the external ring and by following the cord upward with a director or other blunt instrument. If infiltration anesthesia is used the aponeurosis is exposed and injected at the upper end of the proposed line of incision.

The aponeurosis is now incised in the direction of its fibers from a point near the internal ring to the external ring and if the operation is done under infiltration anesthesia the next step is to locate the ilioinguinal and iliohypogastric nerves and blot them as high as possible. The incision should be made as far from the inguinal ligament as is practical so as to provide a wide upper flap for overlapping when the wound is closed. It is always advisable to cut through the pillars of the external ring as this facilitates resection of the sac and repair of the canal. Some operators prefer to cut the aponeurosis on a grooved director inserted upward through the external ring for a distance of 2 to 3 inches (5 to 7.5 cm)—a practice to be condemned (Fig. 63) on account of the danger of cutting the ilioinguinal nerve. A better method is to pick the aponeurosis near the internal ring and cautiously divide it in the direction of its fibers until the external ring is reached.

**Preservation of the Nerves**—The inguinal branch of the ilioinguinal nerve, the hypogastric branch of the iliohypogastric nerve and the genital branch of the genitoexternal nerve are encountered in the operation for inguinal hernia. The ilioinguinal and iliohypogastric nerves supply motor fibers to the external and internal oblique, transversalis and rectus muscles. The ilioinguinal nerve is frequently found adherent to the under surface of the aponeurosis of the external oblique about one inch (2.5 cm.) above the external ring. The iliohypogastric which is the most important nerve lies 1 to 2 inches (2.5 to 5 cm.) above the ilioinguinal and is not often injured unless the incision is long (Fig. 64).

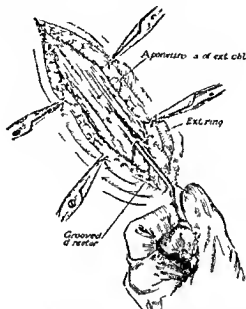


Fig. 63—The wrong way to divide the aponeurosis. There is danger of dividing the ilioinguinal nerve or its terminal branches.

The genital branch of the genitoexternal nerve accompanies the spermatic vessels through the inguinal canal and supplies branches to the cremaster muscle. In the female it accompanies the round ligament. The inclusion of one of these nerves in a ligature may result in a troublesome postoperative neuritis. The division of the nerves is followed by atrophy and trophic disturbances in the muscles which predispose to a recurrence.

Attention has been called to the importance of avoiding injury to the iliohypogastric nerve. Dowd stated that the most common methods of injury are

- 1 Foreible scraping of the internal oblique with scissors and tearing the nerve from its bed in exposing the inguinal ligament.
- 2 Picking up the nerve with forceps and carrying it upward out of harm's way—this tears away all its branches in this area.
- 3 Splitting the external oblique from below and accidentally dividing the nerve.
- 4 Dividing the nerve or including it in a suture just before it enters the aponeurosis of the external oblique. This weakens Hesselbach's triangle. The

above methods of injury might apply equally well to the ilioinguinal nerve although its function is chiefly sensory.

Care must be exercised not to injure the genital branch of the genitoexternal nerve. If it is accidentally caught in a ligature the patient will complain of persistent neuralgic pain in the cord and testis sometimes for months after operation. If the nerve is divided the cremaster muscle will atrophy and the testis will hang low in the scrotum perhaps requiring the patient to wear a suspensory to relieve the dragging pain.

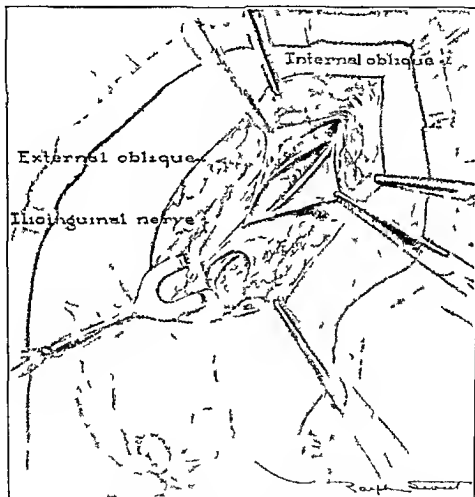


Fig. 64.—Cooper's ligament operation. The aponeurosis of the external oblique has been divided and the ilioinguinal nerve has been exposed.

**Dissection of the Aponeurosis and Anterior Rectus Sheath.**—The inner edge of the external oblique fascia is retracted. On the medial side the dissection is continued until the arching fibers of the internal oblique are seen. The rectus muscle and fascia are exposed. On the outer side the dissection is continued until the inner shelving margin of the inguinal ligament is well exposed for a distance of 2 to 3 inches (5 to 7.5 cm.) down to the pubic tubercle.

If the operation is performed under infiltration anesthesia, the genital branch of the genitoocrural nerve is blocked after lifting up the cord (Fig 65)

On the medial side, the inner layer of the anterior rectus sheath is exposed and split for a distance of 2 to 4 inches (5 to 10 cm) to within  $\frac{1}{2}$  inch (1.25 cm) of the pubic spine. The internal oblique muscle should be cut just to the outer side of the linea alba, which it forms along with the external oblique. This makes it possible to suture the internal oblique fascia and its attached transversalis fascia to Cooper's ligament without undue tension.

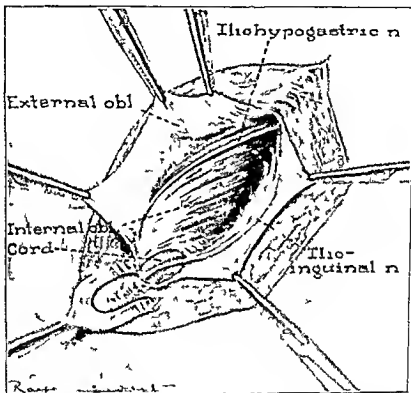


Fig 6 —Cooper's ligament operation. The internal oblique muscle and the iliohypogastric nerve are exposed.

**Locating the Sac**—If there is difficulty in locating the sac, it should be looked for in the region of the internal ring where it is easily found. Another method is to hook up all the cord structures and the sac on the forefinger. Once the indirect hernia sac is found the operator should examine Hesselbach's triangle for a direct hernia and the femoral ring for a possible femoral hernia sac as discussed elsewhere. Should an extra sac be found, simple traction on the indirect sac will convert both of them into an indirect one. I have used this maneuver for years. Huguot was the first to point out the value of this simple procedure.

**Freeing the Sac**—The contents of the inguinal canal are grasped with forceps and lifted up at a point just above the external ring, and the cre

master muscle and the cremasteric fascia incised and dissected from the sac and cord. Now the layer of infundibuliform fascia which covers the sac and cord is incised permitting the sac to be separated easily from the cord (Fig 66)

The spermatic cord can be recognized by feeling the vas deferens and the sac can be identified by the white convex border of the fundus which is lighter in color than the surrounding tissues. If the cord structures are spread out and examined under a good light the fundus of the sac can nearly always be distinguished. The difficult cases are the incomplete hernias of recent formation in which the sac is thin, small and empty. The thickened sac walls of old hernias are easily recognized.

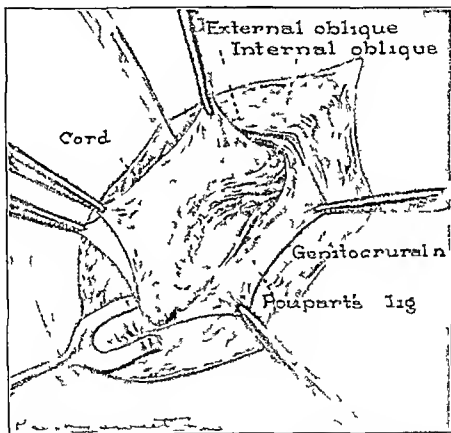


Fig 66—Cooper's ligament operation. The cord and the lower portion of the sac are exposed.

In indirect inguinal hernia the sac is almost always found in front of the cord and to the inner side of it. The adhesions between the sac and cord are most dense in the lower part of the inguinal canal; there are few in the upper portion and here the sac and cord can be most easily separated. The fundus of the sac is grasped with forceps and separated from the cord. The dissection is continued upward until the narrow part of the neck is passed and the sac begins to widen out and blend with the parietal peritoneum of the abdominal cavity (Fig 67). At this point the peritoneum is whiter, denser, and



thinner than the hernial sac. Properitoneal fat will be found, and if the dissection is high enough, the deep epigastric vessels will be seen.

**Opening the Sac.**—Before opening the sac the contents should be reduced, if possible, and the sac opened very carefully to avoid injury to viscera whose presence in the sac is not suspected. If the sac is empty, it is freed about an inch (2.5 cm.) inside the internal ring. If the hernia is irreducible or

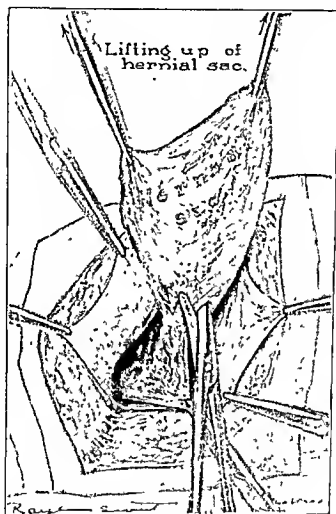


Fig 67—Cooper's ligament operation. The hernial sac is freed up to the internal ring

if it contains adherent omentum, it is sometimes necessary to open the sac, separate the adhesions and reduce the contents before freeing the sac. Traction on the walls of the sac will usually prevent the protrusion of viscera (Fig 68.)

**Omentum in the Sac**—Healthy omentum should be returned to the abdominal cavity. Excision of omentum is indicated in the following conditions in strangulated hernia; when the omentum cannot be reduced; when the omentum is diseased, and in obese subjects to lessen the intraabdominal tension.

The chief dangers of the excision of the omentum are slipping of the ligature with secondary hemorrhage, infection of the portion of omentum lying beyond the ligature, epiploitis, and thrombosis or embolism.

Omental adhesions that are firm and vascular should be divided between fine silk or cotton ligatures. If the intestine or its mesentery is adherent to the sac,



Fig 68.—Cooper's ligament operation. The sac is opened and the examining finger explores the internal ring and locates the position of the bladder, the condition of Hesselbach's triangle and the femoral ring.

no attempt should be made to separate them, but the sac trimmed around the adhesions and left attached to the intestine or mesentery. Later the edges are sutured together to cover the raw surfaces so as to prevent the formation of new adhesions.

**Method of Ligating Omentum.**—When it is necessary to reset omentum, fine silk or cotton should be used for the ligature. The ligating should be done in

small sections a piece of omentum no larger than the little finger being included in each ligature. To prevent slipping each pedicle of omentum should be transfixed by the ligature before it is tied and the omentum should be cut off  $\frac{1}{2}$  inch (1.25 cm) below the ligature. The Staffordshire (or Tut) knot is used by many surgeons.

When the internal ring is so small that the omentum cannot be reduced the latter should be ligated in sections with each ligature at a different level, otherwise it may be difficult to return the omental stump to the abdominal cavity.

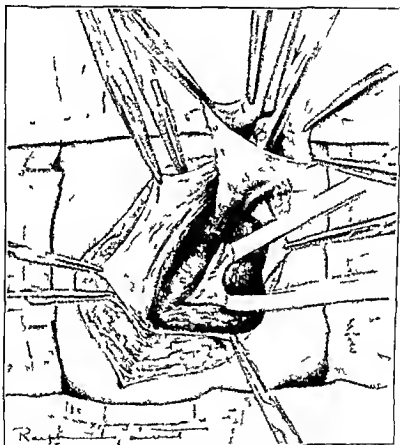


Fig. 62—Cooper's ligament operation. A light forceps is used to keep the omentum from protruding through the ring preparatory to placing the suture.

**Disposition of the Sac**—In congenital hernia if the sac communicates with the tunica vaginalis testis it cannot be completely removed as the fundus is intimately adherent to the testis and it is necessary to leave a portion of the sac opposite the testis. If too much is left a secondary hydrocele is liable to form. I usually cut off the sac  $\frac{1}{2}$  to  $\frac{1}{2}$  inch (1 to 1.25 cm) from the testis all around. I have seen necrosis of the testis follow an operation in which the surgeon attempted to strip the tunica vaginalis from the testis.

**Ligation of the Sac**—When operating under local anesthesia it is a good plan to inject the neck of the sac before transfixing and ligating it. In small

hernias traction is made on the sac, and a transfixing ligature of medium silk or cotton No 30 is passed through the neck of the sac well within the internal ring. Before the ligature is tied, the sac should be pulled down and held open for inspection to make sure that no omentum, intestine or bladder is caught in the ligature, which is now tied high up, while traction is made on the sac (Fig 69). If the neck of the sac is large, a purse string suture is often more satisfactory than a simple ligature. If the sac is ligated high enough, there will be a good spring back of the stump, which will be drawn up inside the internal ring by the elasticity of the peritoneum (Fig 70).

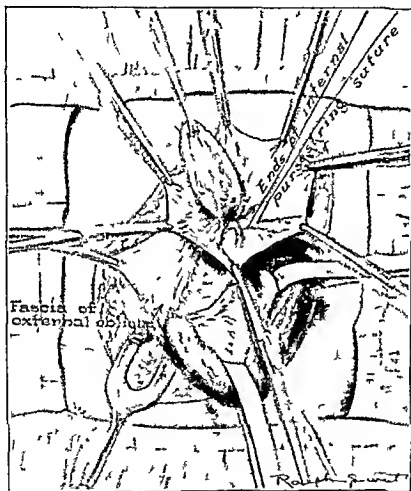


Fig 70—Cooper's ligament operation. A purse string suture is placed inside the neck of the sac well within the internal ring.

If any portion of the sac is left behind due to the dissection not extending high enough or to faulty ligation, a funnel shaped process of peritoneum will be left and the hernia is liable to recur. The object is to reconstruct the depression of peritoneum between the plicae urachi and the plicae hypogastricae—the internal inguinal fossa—and to obliterate the funnel shaped opening leading to the sac.

When the neck of the sac is very wide, and especially if the bladder is involved in the posterior wall or can be pulled down by making traction on the

sac, I have found it a good plan to cut the sac transversely and close it by interrupted sutures as in any other peritoneal wound. Sometimes it is advisable to place a second row of sutures in the peritoneum to lessen the tension on the first row and prevent it from giving way.

**Accidents to Be Avoided During Ligation**—The dangers to be borne in mind during ligation are: accidental puncture of the bladder or the epigastric vessels with the ligature needle, the transfixion of omentum or intestine with the ligature needle, the inclusion of omentum, intestine or vas deferens in the ligature of the sac.

**Leaving the Scrotal Portion of the Sac in Situ**—In large scrotal hernias when dissection of the sac is difficult and tedious and the patient's condition calls for a speedy operation there is no particular harm in dividing the sac below the neck and leaving the scrotal portion. In these cases I often turn down a tongue from the wall of the sac, paint the inner surface with iodin, suture the tongue to the bottom of the sac and occlude the walls with fine silk or cotton sutures.

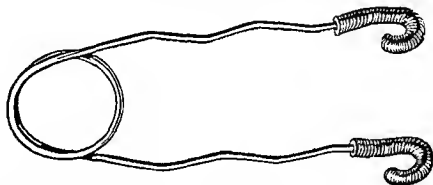


Fig 71.—The author's cord retractor. The points of the retractor are covered with rubber tubing.

**Deep Sutures to Cooper's Ligament**—The most important step of the operation is the suturing of the transversalis fascia to Cooper's ligament. In large hernias the aponeurosis of the internal oblique is also sutured to Cooper's ligament. At no time is the red muscle of the internal oblique included in the sutures. If the red muscle is stitched it quickly cuts out and paves the way for an early recurrence of the hernia. The cord should be handled as little as possible. It should be retracted by an instrument that does not compress it rather than by the common practice of passing a strip of gauze beneath it which may cause torsion of the cord when the latter is replaced in the internal ring next to the peritoneum. Traumatism of the cord is responsible for most of the after pain as well as the occurrence of epididymitis, orchitis and rarely thrombosis and embolism. (Fig 71.)

With the cord gently retracted to the inner side the first stitch is taken in the form of a purse string suture of the fascia around the internal inguinal ring with heavy silk or cotton No 30. A similar partial purse string stitch in the transversalis fascia closes the internal ring around the spermatic cord. A heavy silk or cotton No 20 suture on a round pointed full curved needle is

passed through the transversalis fascia and aponeurosis of the internal oblique (Figs 72 and 73). Next the needle passes outward through the thickened Cooper's ligament along the upper border of the pubic ramus. This stitch is taken usually about 2 inches (5 cm) from the spine of the pubis while the femoral vessels are protected by the operator's index finger on the crest of the pubic bone. The highest stitch is placed first and tied usually 1 to 2 inches (2.5 to 5 cm) laterally from the pubic spine. This is to protect the femoral vessels. The two sutures closest to the pubic spine pass through the lacunar

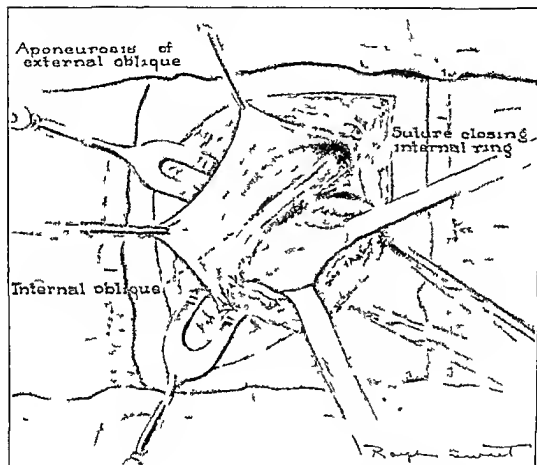


Fig. 73—Cooper's ligament operation. Suture of the internal ring.

(Gimbernat's) ligament as well as Cooper's ligament. In all four or five sutures are used and they should be No. 5 heavy braided silk or cotton No. 20. The knots of the tied sutures should be cut very close. If the femoral vein is difficult to locate or if there is a large Rosenmüller's gland it is advisable not to attempt to carry the sutures more than halfway from the pubic spine to the femoral vessels (Fig. 74).

In order to make the opening as small as possible all fat and other tissue should be dissected away from the cord and nothing allowed to remain but the vas deferens, artery, nerve, and veins. After the deep sutures are tied a stitch

is placed above the cord, as recommended by Coley (W. B.), and passed through the upper part of the internal ring to narrow the ring and strengthen it, thus lessening the danger of recurrence. The internal ring should be closed as snugly as possible around the cord, there being little danger of getting it too tight. If there is any question on this point, however, the pulsation in the spermatic artery may be felt.

Care must be exercised to avoid tying the sutures too tight and to guard against puncturing the deep epigastric and external iliac vessels.

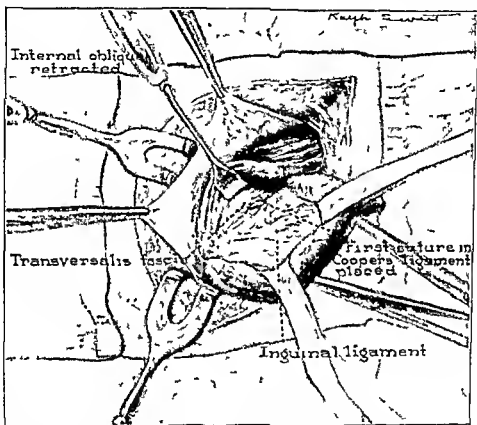


Fig. 73.—Cooper's ligament operation. Suture of the transversalis fascia to Cooper's ligament.

**Flexion of Thigh to Facilitate Approximation of the Deep Sutures**—The best exposure of the field of operation is obtained by keeping the thigh extended until the deep sutures are ready to be tied, when it should be elevated and adducted. This reduces the distance between the inguinal ligament and the internal oblique and the conjoint tendon from 25 to 50 per cent, depending on the size of the opening and the development of the muscles, and the suture can be tied without tension, even in large hernias. Newman pointed out the value of this procedure, and Lyle found in studying a series of hernia operations that the distance between the inguinal ligament and the conjoint tendon could be reduced 20 to 70 per cent by flexing the thigh.

**Closing the Aponeurosis of the External Oblique**—The cord is replaced on its new floor, which is formed by the internal oblique and conjoint tendon. The cut edges of the aponeurosis are freed from fatty connective tissue and sutured together from above downward by interrupted sutures of silk or cotton No 40, leaving just enough room in the new external ring for the cord. The flaps of aponeurosis are overlapped from above downward in a double breasted fashion to strengthen the aponeurotic covering of the new inguinal canal and to take the strain off of the deep sutures (Fig 75)

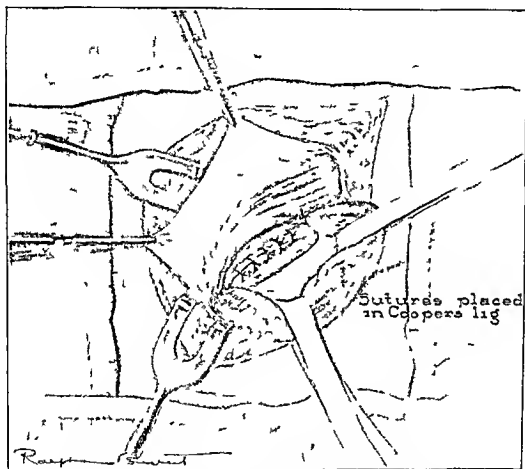


Fig 74—Cooper's ligament operation. Aponeurosis of internal oblique and transversalis fascia sutured to Cooper's ligament

**Closing the Subcutaneous Tissues and Skin Incision**—The fat is brought together with interrupted sutures of fine silk or plain cotton No 80 and the skin incision closed by interrupted or mattress sutures of fine silk or plain cotton No 80. When the cosmetic result is important, it is best to use a subcuticular suture (Fig 76)

**Disadvantages of the Cooper's Ligament Operation**—Many surgeons maintain that the Cooper's ligament operation is more difficult than other operations for inguinal hernia and cite the following objections: it is more



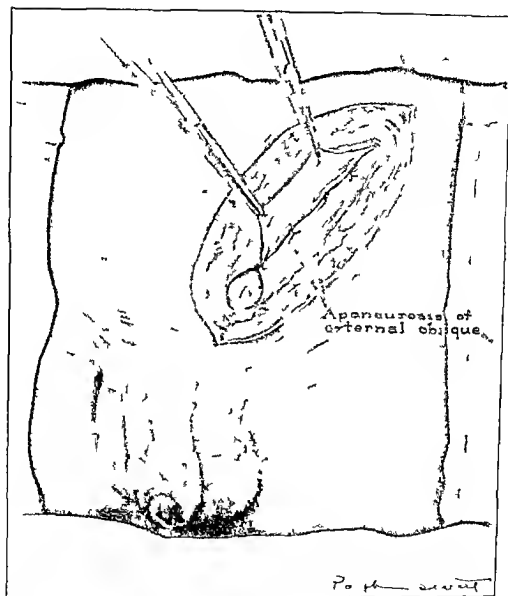


Fig. 7a.—Cooper's ligament operation. The flaps of the aponeurosis of the external oblique are overlapped with interrupted sutures.

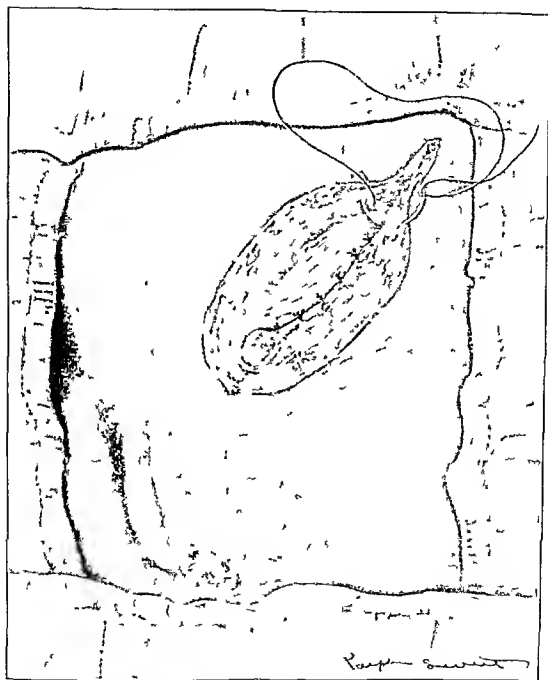


Fig 7c—Cooper's ligament operation. The subcutaneous fat and skin wound are closed with interrupted sutures

difficult to expose the Cooper's ligament on account of its location, there is more danger of injuring important blood vessels there is danger of temporary edema of the leg on the side of the operation. Cooper's ligament is at times small and undeveloped and cannot be depended upon it is often difficult to obtain adequate support for the inguinal ring and it is then necessary to use additional supporting sutures after the fascia has been sewed to Cooper's ligament, the operation takes more time than other procedures.

### HALSTED'S OPERATION

**1 Indirect Hernia**—In 1889 Halsted described an operation the technique of which is as follows. The skin and aponeurosis are incised in the usual manner, the flap of aponeurosis of the external oblique is dissected back, exposing the conjoint tendon and internal oblique muscle and the cremaster is incised longitudinally. The sac is opened and separated from the cord by sharp dissection freed to the internal ring, twisted transfixed by a ligature tied and excised.

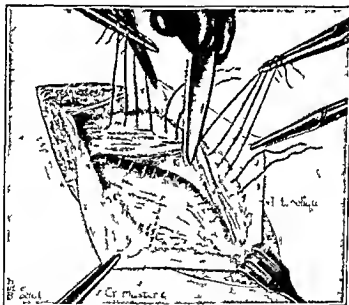


FIG. 77.—Halsted's operation for indirect inguinal hernia. The operation up to the point of closure is similar to that already described. Mattress sutures are passed through the conjoint tendon, internal oblique, cremaster muscle and fascia then back through the conjoint tendon and internal oblique and tied. The important step in this operation is the utilization of the cremaster muscle and fascia. The cord is not disturbed.

The important point in the operation is pointed out by Brenner and by Halsted is the utilization of the cremaster muscle and fascia. Mattress sutures of fine silk are passed through the conjoint tendon, internal oblique, cremaster muscle and fascia then back through the conjoint tendon and internal oblique and tied. The cremaster should be drawn up under the conjoint tendon and internal oblique without tension on the sutures. The cord is left undisturbed. Next the edge of the conjoint tendon and the edge of the internal oblique are

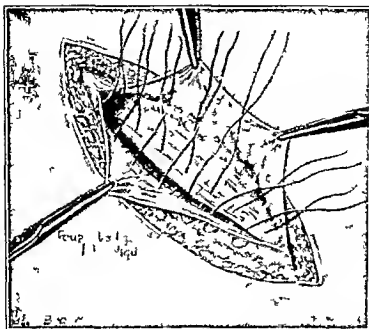


Fig. 68—Halsted's operation for indirect inguinal hernia. The edge of the conjoint tendon and the edge of the internal oblique are sutured to the inguinal ligament.

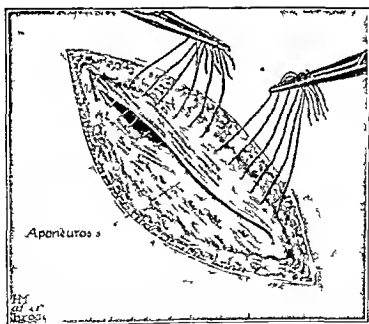


Fig. 70—Halsted's operation for indirect inguinal hernia. The flaps of aponurosis are overlapped from above downward and sutured.

sutured to the inguinal ligament. Homans transplants the cord into the fatty subcutaneous layer above the aponeurotic structures.

Richhoff closes the lower or critical angle of the inguinal triangle by incising the rectus sheath down to the superior ramus of the pubic bone and upward as far as the reflection of the aponeurosis of the external oblique will permit. The released rectus fascial is sutured to the inguinal ligament with the Halsted technique. Wangenstein ascribes the success of the Halsted operation to the use of nonabsorbable sutures.

The flaps of aponeurosis of the external oblique are overlapped; the edge of the upper flap is stitched to the outer surface of the conjoint tendon and the internal oblique; the lower flap is brought down and sewed to the outer flap with fine silk, and the superficial fascia and skin are closed. (128 77 79)

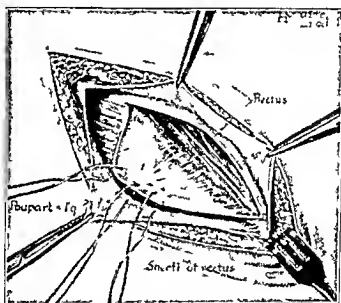


Fig 80—Halsted's operation for direct inguinal hernia. A triangular flap secured from the anterior sheath of the rectus is turned down and sutured to the inguinal ligament.

**2 Direct Hernia**—In direct hernia the cord is sometimes transplanted. If the conjoint tendon is deficient a triangular flap of fascia is transplanted from the anterior rectus sheath and used to cover the gap (Fig 80).

Halsted discontinued the excision of veins in the cord. Although this step lessened the percentage of recurrences, hydrocele developed in 20 per cent of the cases while it occurred only in 4 per cent of the cases in which the veins were not excised. I want to call attention to the importance of including the cremaster muscle in the deep sutures to strengthen the suture line, especially in the repair of direct hernia.

### BABCOCK'S OPERATION

Babcock has had outstanding success with fine 38 to 30 stainless steel wire used as an interrupted suture and tied in a square knot with the ends cut very

short. He believes this material is superior to silk, cotton, or catgut, and states he has not used silver wire for years as it invariably breaks or fragments. He has succeeded in closing enormous abdominal hernias with the fine alloy steel where heavy silver wire and other suture materials failed to hold.

**The Operation**—A transverse  $\frac{1}{2}$  inch (10 cm) incision is made following the line of skin cleavage centering over the abdominal inguinal ring. The superficial epigastric and superficial circumflex iliac vessels are divided and ligated with 36 alloy steel wire. The aponeurosis of the external oblique is split over the inguinal canal between fibers from the subcutaneous ring to a point well beyond the abdominal ring. The upper edge of the external oblique aponeurosis is reflected upward exposing the inner layer of the sheath of the rectus. The internal oblique and transversalis muscles are retracted and the sac is located. If not easily found the peritoneum is opened above the abdominal ring and the sac is located by the finger introduced through the abdominal incision. The sac is opened, the contents examined and liberated, bleeding points ligated and the contents returned to the abdomen. The sac is separated from the cord by knife and dry gauze dissection, the sac being removed or, if scrotal and very large or of the congenital type divided at the neck of the sac and retained. The neck of the sac is transixed and ligated with 32 alloy steel wire or silk, the ends of the ligature are threaded into curved needles being brought from within out through the edge of the rectus muscle and the inner layer of its anterior sheath. Hesseltieh's triangle is reinforced by uniting the edge of the rectus with the deep layer of its sheath and the conjoined tendon *in front of the cord to Cooper's ligament on the edge of the pubis and pubic ramus* by two to four interrupted sutures of 30 stainless steel wire or silk. The edge of the deep layer of the rectus sheath lateral to this is approximated to the shelving portion of the inguinal ligament with interrupted sutures of 30 wire as far as possible after which the internal oblique and transversalis are united to the shelving portion. The neck of the sac is transplanted to a higher level behind the rectus muscle by carrying the ends of the ligature through corresponding portions of the shelving part of the inguinal ligament and tying. The edge of the inguinal ligament is brought over the suture lines and sutured with interrupted 30 or 32 wire sutures over the inner layer of the anterior sheath of the rectus muscle which has been carefully separated from the outer layer well to the midline, the aponeurosis of the external oblique is brought down over all suture lines and united below the inguinal ligament to the fascia lata. In the inner angle if the weakness is marked a separate suture is used to fasten the edge of the external oblique to the sheath of the pectineus muscle. Interrupted sutures of 35 wire are used to unite the subcutaneous fat and the skin is closed with interrupted 35 and continuous 38 wire sutures.

This operation transplants the closed neck of the sac but not the cord, reinforces the weak conjoined tendon by uniting the rectus in its inner sheath to the strong ligament of Cooper and by two additional strong fascial layers. It is rarely followed by complications within the scrotum.

The operation utilizes the transplantation of the neck of the sac of Kocher and Halsted, the imbrication of layers of Halsted and the use of nonabsorbable

interrupted sutures without depending on the suture of red muscle for support. Bloodgood's transplantation of the rectus muscle from its sheath is made more secure by transplanting the muscle in its inner sheath not only to the shelving portion of the inguinal ligament but especially to Cooper's ligament.

### INGUINAL LIGAMENT OPERATION WITH LOCAL ANESTHESIA

The inguinal ligament operation better known as the Bassini operation is still used by a majority of surgeons throughout the world. The local anesthesia technique is adaptable to any hernia operation.

The steps are much the same as in the Cooper's ligament operation up to the placing of the deep sutures. The insertion of the deep sutures is carried out in the following manner. With the cord retracted out of harm's way, the first stitch is taken at the upper end of the inguinal canal. A round pointed full curved needle threaded with No. 5 doubled heavy braided silk or No. 20 cotton is passed through the internal oblique and transversalis muscles and if possible through the transversalis fascia also which forms the internal ring proper. Bassini who first emphasized the importance of this stitch, pushed a small flat director into the internal ring next to the peritoneum and lifted up all the structures except the peritoneum to make sure that the transversalis fascia was caught in the bite. Next the needle passes outward through the cremaster muscle and finally through the inner shelving edge of the inguinal ligament (Poupart's ligament). This suture should be inserted sufficiently high to touch the lower border of the uplifted cord and should not be tied until the rest of the deep sutures have been placed. Three to five deep sutures are usually required and are placed  $\frac{1}{2}$  inch (8 mm) apart. The two or three upper ones should take a bite in the cremaster muscles as suggested by Breuner and Halsted while the two lower ones approximate the conjoined tendon to the inguinal ligament, and in large hernias to the lacunar ligament also. The lowest suture is one of the most important and should be passed first in the following manner.

The external oblique muscle is retracted inward and the ilioinguinal nerve which has been retracted to the inner side is released and permitted to drop back into its normal position. The needle is passed through the reflected portion of the external oblique aponeurosis,  $\frac{1}{2}$  inch (8 mm) above the point where the muscle meets the conjoined tendon. It crosses over the nerve and picks up the outer portion of the conjoined tendon and then passes beneath the cord and enters the lower part of the inguinal ligament (Poupart's ligament) close to its attachment to the pubic spine and includes a bite in the periosteum. This stitch does not compress the ilioinguinal nerve if it were to do so it would cause postoperative neuralgic pain or neuritis. (Fig. 96)

For many years when using the inguinal ligament operation for indirect hernia I have placed two or three deep sutures just above the pubis passing through the sheath of the rectus and the periosteum over the spine of the pubis. Robins also takes advantage of the thick ligamentous covering of the pubic bone and employs black cotton No. 20 sutures to attach the heavy rectus muscle

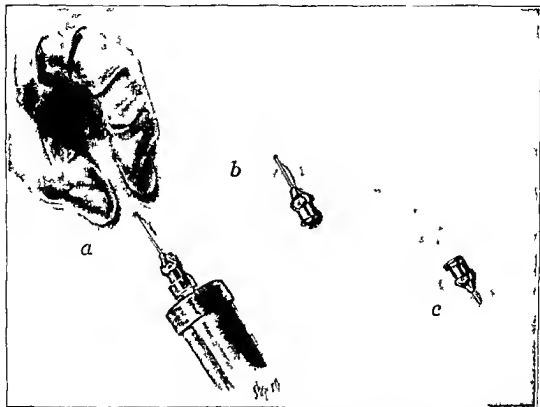


Fig 81.—Infiltration anesthesia for inguinal hernia operation. (a) The first injection of the skin is usually made near the center of the proposed line of incision. (b) The infiltration is continued upward. (c) The lower part of the incision is injected.

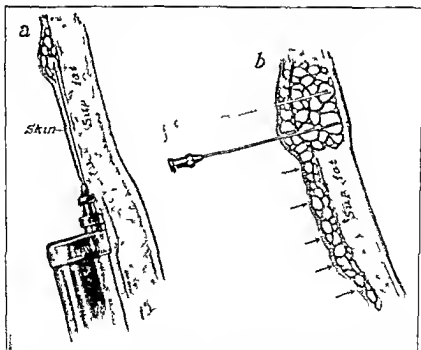


Fig 82.—Infiltration anesthesia for inguinal hernia operation. Cross section showing (a) the anesthesia of the skin. (b) the infiltration of the subcutaneous tissues down to the aponeurosis.



fascia to the pubic bone. The sutures are continued outward so as to make an adequate barrier to any subsequent descent of the hernia. He believes most recurrences are due to the fact that the average operation leaves a small aperture where the muscle is deficient in the region of the external inguinal ring.



Fig. 53.—The skin incision is made straight and nearly parallel with Poupart's ligament, and  $\frac{1}{2}$  inch (1.3 cm.) above it. It extends from the internal ring to the external ring or to the center of the upper part of the scrotum in large hernias.

Care must be exercised to take a good bite in the conjoint tendon to catch the inner shelving edge of the inguinal ligament (Poupart's ligament) and not the free cut edge of the aponeurosis of the external oblique to avoid tying the sutures too tight and to guard against puncturing the deep epigastric and external iliac vessels.

In order to make the opening as small as possible all fat and other tissue should be dissected away from the cord and nothing should be allowed to re-

main but the *vas deferens*, artery, nerve, and veins. After the deep sutures are tied, a stitch is placed above the cord, as recommended by Coley, and passed through the upper part of the internal ring to narrow the ring and strengthen it, thus lessening the danger of recurrence. The internal ring should be closed as snugly as possible around the cord, there being little danger of getting it too tight. If there is any question on this point, however, the pulsation in the spermatic artery may be felt. Bassini placed a small director in the ring before tying the suture and removed it when the suture was tied; in this way there is no danger of getting the stitch too tight.

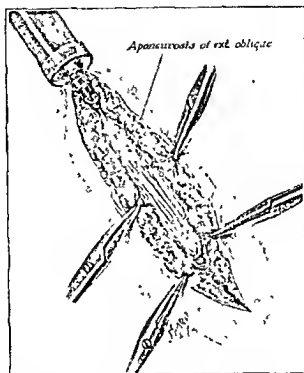


Fig 84—Method of infiltrating the aponeurosis of the external oblique before it is incised.

**Closing the Aponeurosis of the External Oblique.**—The cord is replaced on its new floor, which is formed by the internal oblique and conjoined tendon. The cut edges of the aponeurosis are freed from fatty connective tissue and sutured together from above downward by interrupted sutures of silk or cotton, leaving just enough room in the new external ring for the cord. The flaps of aponeurosis are overlapped from above downward in a double-breasted fashion to strengthen the aponeurotic covering of the new inguinal canal and to take the strain off the deep sutures. (Fig 97) The fat is brought together by interrupted sutures of fine silk or cotton No 80, and the skin is closed by a continuous subcuticular stitch of fine silk or cotton No. 80, without drainage. (Figs. 98 and 99)

**Why Hernias Recur After Bassini Operations.**—The principal factors in the cause of recurrence after the Bassini operation are anatomic and operative.

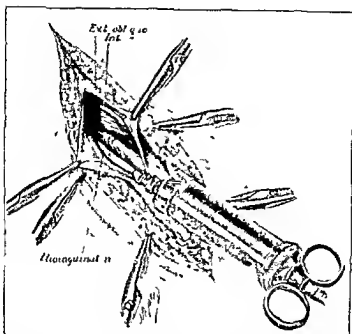


Fig. 85.—The anconeurosis has been divided, and the iliohypogastric and ilioinguinal nerves have been exposed. Method of blocking the ilioinguinal nerve in its sheath.

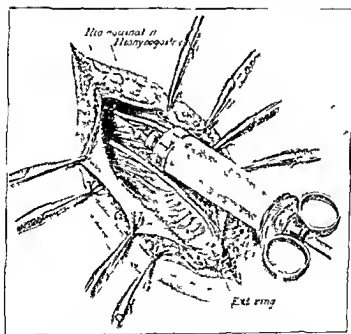


Fig. 86.—Method of blocking the iliohypogastric nerve in its sheath. Note that the nerve is blocked as high as possible in the incision.

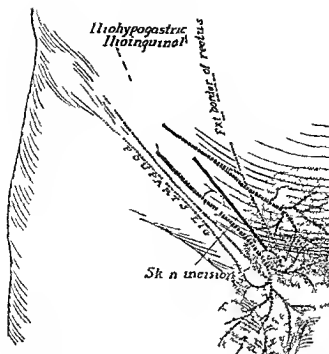


Fig 87—The course and distribution of the Iliohypogastric and Ilioinguinal nerves

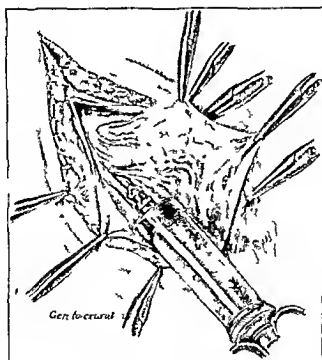


Fig 88—The cord is lifted up and the genital branch of the genitocrural nerve which lies behind the cord is blocked

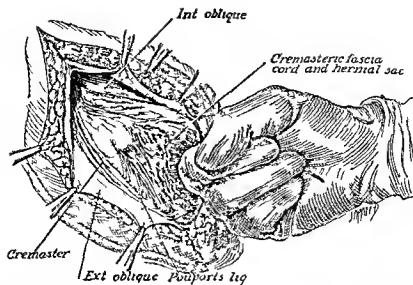


Fig 89—If there is difficulty in locating the sac in the region of the internal ring, where as a rule it is easily found, the cord structures and sac can be looked up on the forefinger.

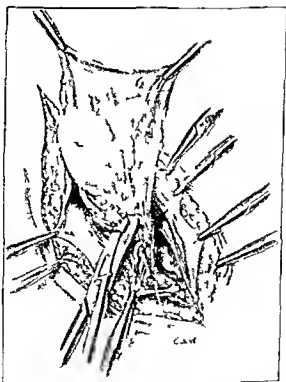


Fig 90—Feeling the sac from the cord structures by sharp dissection.

Anatomically, there is a deficiency in the fascia formation of the transversalis and internal oblique. The so called weak spot has for support only peritoneum and transversalis fascia because the internal oblique fascia does not develop sufficiently to form a broad insertion into the pubic crest, but has only a narrow attachment to the rectus sheath. This leaves an inguinal triangle, or weak spot bounded by the inguinal ligament, the rectus sheath, and the lower border of the rectus muscle. Anson and McNay found the distance from the insertion of the lower border of the internal oblique muscle to the pubic crest varied from 0.0 to 9 cm, averaging 2 to 5 cm. Carnes found the measurements averaged

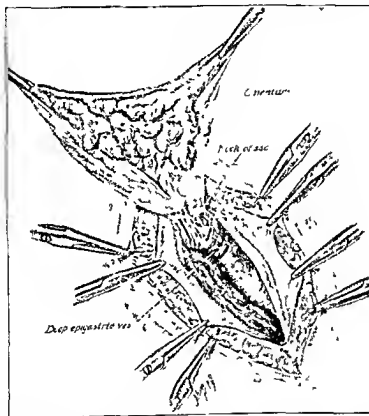


Fig. 81.—The dissection is continued upward to the internal ring until the narrow part of the sac is passed, and the sac begins to widen out and blend with the parietal peritoneum of the abdominal cavity. If the dissection is high enough the deep epigastric vessels are seen. The sac is opened.

approximately the same, 2 to 4 cm. From an operative standpoint the fault in the Bassini operation lies in the fact that the method does not give the needed support to the internal inguinal ring or the area lateral to the pubic spine. These are the fundamental weak spots in the inguinal region and the usual site of recurrences. Brandon, McLaughlin, Stein, and others describe procedures for reinforcing the internal inguinal ring. Bean and Gillespie emphasize the necessity of a tight closure at the lower end of the deep suture line.

Bassini's statistics were unduly optimistic because he thought it necessary to follow up his cases for only six weeks after operation.

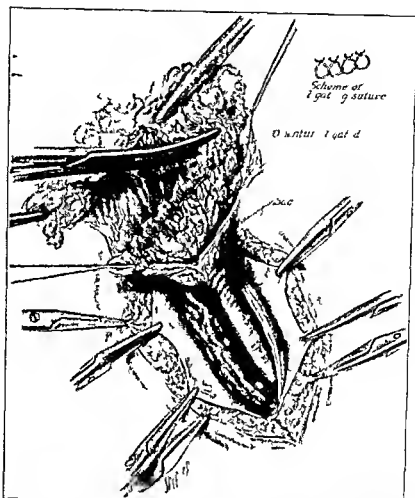


Fig 9 —The lithic omentum is returned to the abdominal cavity. Irreducible or diseased omentum should be ligated in small sections to lessen the danger of embolism. When the internal ring is small, each ligature is applied at a different level, otherwise it may be difficult to return the omentum to the abdominal cavity.



Fig 93

Anesthetizing the neck of the sac

Fig 94

Fig 93 —Opening the sac and blocking the parietal peritoneum beyond the internal ring.  
Fig 94 —Infiltrating the neck of the empty sac without opening it.

While the original Bassini operation marked an epoch in hernia surgery, it is apparent that Bassini's incision was too high to reach the pubic bone and the deficient transversalis fascia and conjoint tendon, the usual point of hernia recurrence. The conjoint tendon is an uncertain and unsatisfactory support for the weak posterior wall of the inguinal canal. At times, it does have an

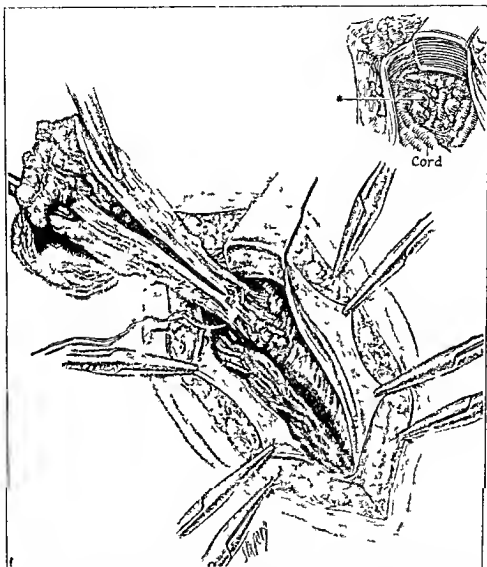


FIG. 63.—Ligation of the sac. In small hernias traction is made on the sac and a transfixing ligature or a purse-string suture is passed through the neck of the sac well within the internal ring. If the sac is excised high enough there will be a good spring back of the stump which will be drawn up inside the internal ring by the elasticity of the peritoneum. (Insert shows closure of a large hernial sac stump by suture of the peritoneum.)

insertion into the ligamentous covering of the pubic bone but only into the rectus sheath at a varying distance above the pubis. Mair, in a series of 100 operations, found a strong conjoint tendon inserted into the pubic fascia in only 46 cases.



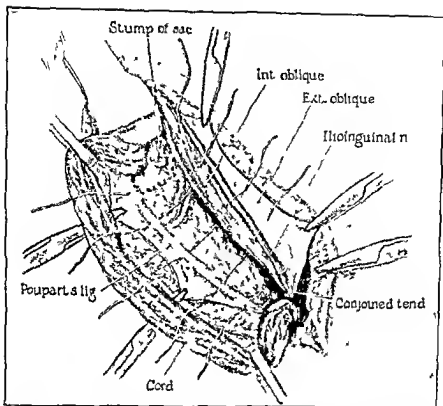


Fig 96—Method of passing the deep sutures (See text for detailed description)

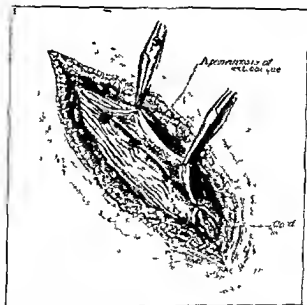


Fig 97—The cord is replaced on its new bed formed by the internal oblique and conjoined tendon. The flaps of aponeurosis are overlapped from above downward in a double-breasted fashion to strengthen the aponeurotic covering and to take some of the strain off the deep sutures.

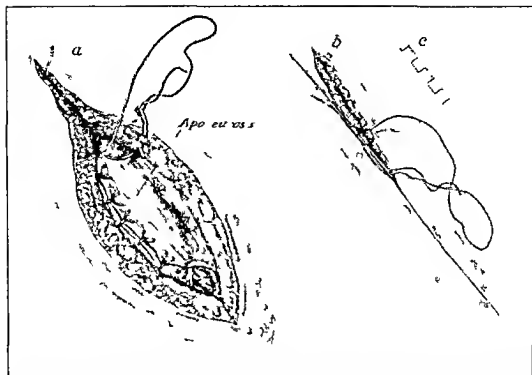


Fig 88—The overlapping of the aponeurotic flaps is completed. (a) The subcutaneous fat is brought together by interrupted sutures. (b) The skin wound is closed by a continuous subcuticular suture or interrupted sutures of fine silk or cotton No 60 without drainage. (c) Schema of the subcuticular suture.

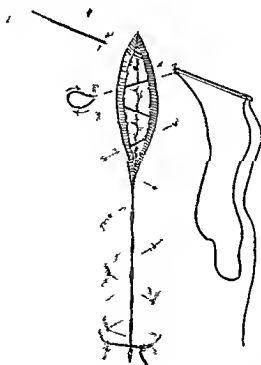


Fig 89—A simple and quick method of subcuticular cosmetic skin suture.

**Medial Displacement of the Cord**—This procedure is simply an additional step in technique. Everybody knows that if recurrence does follow the hernia operation it almost always takes place at the internal ring at the lower end of the incision over the pubic bone or in the line of deep sutures. The procedure that I employ helps to reinforce these weak spots. I have used it since 1916 in suitable cases and it has given a lower percentage of recurrence than the usual operation.

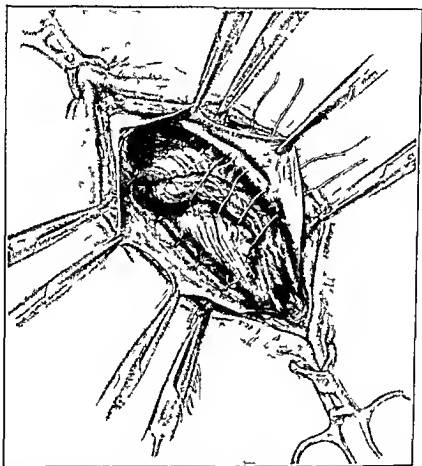


Fig. 100—Inguinal hernia operation. The author's method of displacing the cord to get it away from the suture line thus lessening the danger of recurrence.

The regular operation is followed up to the point where the cord is transplanted. The cord is made as small as possible by removing all its fatty coverings leaving only the vas deferens and the spermatic vessels. The upper flap of the aponeurosis is freed from the internal oblique as far as the outer border of the rectus muscle.

The cord is placed on the internal oblique  $\frac{1}{2}$  to 1 inch (12.5 to 25 mm) internal to the deep suture line the exact distance depending on the length of the cord and retained in this position by one or two interrupted sutures. These sutures are inserted external to the cord internal to the deep suture line.

and they unite the inner surface of the aponeurosis to the internal oblique and conjoint tendon (Fig 100)

Sometimes it is advisable to place an additional stitch internal to the internal ring just above the cord and I often suture the aponeurosis to the deep suture line as high as the lower edge of the internal ring. The flaps of aponeurosis are overlapped by bringing the edge of the upper flap down and stitching it to the under surface of the lower flap which is then turned up and tacked to the upper flap.

This method of closure reinforces the internal ring by changing the angle of the cord as it leaves the ring and by getting the cord away from the deep suture line. It places a strong double breasted barrier of aponeurosis directly over the internal ring and the deep suture line. It permits firm union between the fascia and the aponeurosis along the deep suture line so that the internal ring and the line of deep sutures the usual points of recurrence following the regular operation are doubly reinforced.

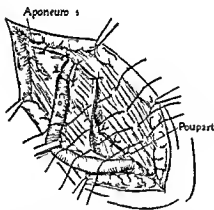


Fig 101

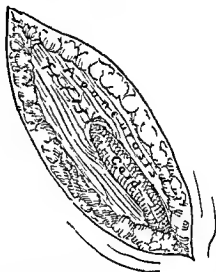


Fig 100

Fig. 101—Stetten's method brings the cord through a slit in the lower flap of aponeurosis which is carried across the cord and overlapped on the upper flap.

Fig. 100—Scott's method brings the cord through the overlapped aponeurotic flaps at a point halfway down the line of incision. This gives an oblique inguinal canal and permits the lower end of the wound to be closed firmly.

There is no danger of getting the sutures tight enough to cause pressure on the cord in spite of the increased length of the canal because the bed for the cord is formed entirely by muscle and no pressure is exerted on the cord from the inner side.

This operation cannot be used when the spermatic cord is abnormally short as in hernias associated with maldescended or undescended testes or in recurrent hernias when the aponeurosis of the external oblique is deficient or has been replaced by scar tissue. When the internal oblique is deficient the reinforcing sutures unite the aponeurosis to the cremaster and the transversalis muscles.

**Closure or Obliteration of the Internal Ring**—Many operations have been devised to tighten or obliterate the internal inguinal ring. Stein has devoted much study to the subject and has published a very ingenious operation. Stetten

brought the cord through a slit in the aponeurosis of the external oblique muscle while Scott brought the cord through the center of the overlapped aponeurosis. Numerous variations of these methods have been published.

### DIRECT INGUINAL HERNIA

The operation for direct inguinal hernia is not followed by the same high percentage of cures that is the rule in the indirect variety. Several factors are responsible for this state of affairs. They are neglect in recognizing the direct hernia at operation, failure to realize that the ordinary operation for indirect hernia is insufficient in the direct type, bilateral operation, a poor selection of cases, and the fact that the direct hernia is usually a recurrence which makes the closure much more difficult.

A number of modifications of the indirect hernia operation have been devised for the cure of direct hernia, and when the hernia is small some surgeons do not transplant the cord.

**Direct Hernias That Usually Recur After Operation**—There are a certain percentage of direct hernias that can seldom be cured by operation. Large direct hernias in the obese or in subjects who have poorly developed abdominal muscles in both lower quadrants, hernias that bulge from the anterior superior spine to the edge of the rectus, and those that show on examination almost complete absence of the conjoint tendon and a separation of the aponeurosis of the external oblique.

**Varieties of Direct Hernia**—There are two forms of direct hernia. The first variety pushes its way through the conjoint tendon and emerges at the external ring. The second variety bulges around the outer and lower edge of the conjoint tendon and decreases in size as it extends outward toward the deep epigastric artery. This type of hernia is usually more favorable for operation than the first variety.

**Bladder in Direct Hernia**—The principal danger in operating on direct hernia is injury to the bladder, which is frequently adherent to the inner wall of the sac. Prevesical fat on the innerside of the sac should always be looked for, and the sac must be opened on its outer side as far as possible from the inner wall. With the sac held open, the bladder can often be seen as a fluctuating cystic tumor below and toward the median line. Traction on the sac wall causes the tumor to disappear, but it recurs as soon as tension is released. (For further information see the chapter on hernia of the bladder.)

Willie found the bladder present in 50 per cent of 42 direct hernias. I believe that it is practically always in the inner part of a direct hernial sac.

**Injury to the Bladder**—The treatment of accidental injuries to the bladder is fully considered in the chapter on hernia of the bladder. If the bladder is in the sac, the latter should be carefully resected at a safe distance from the bladder, and the neck of the sac closed by a purse string suture or preferably by a running suture such as is used for peritoneal suturing elsewhere, sewing from within outward so there will be no unnecessary pulling on the bladder.

**Recurrent Inguinal Hernia**—Recurrent inguinal hernias are almost all ways of the direct variety, even when the original protrusion was indirect. The

importance of making a wide dissection, and securing broad fascial flaps well beyond the scar tissue of the previous operation before attempting to deal with the sac, cannot be overemphasized. The vas deferens and spermatic vessels may be found anywhere in the scar tissue, their position depending on the technique of the former operation. They may be above the aponeurosis, between the layers of the aponeurosis, they may lie on the internal oblique, or they may be found below the internal oblique and transversalis.

### Operation for Direct Inguinal Hernia

Many surgeons make the mistake of trying to adapt the indirect hernia operation to direct hernia. This in part accounts for the high recurrence rate

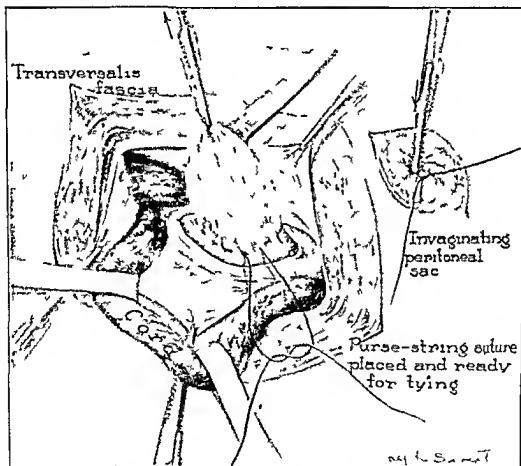


Fig 103—Operation for small direct inguinal hernia. A purse string suture is placed around the neck of the sac and tied as the sac is invaginated.

in direct hernia operations. While the indirect hernia is congenital and descends through the internal inguinal ring into a long narrow sac in the inguinal canal, the situation in direct hernia is very different from an anatomical standpoint. The cause of direct hernia is a deficient fascial floor in the lower portion of the inguinal canal and Hesselbach's triangle. The sac is oval or

saucer shaped and has a wide base which is in close proximity to the bladder on its medial side. For this reason it is best not to open the sac unless it presents a long narrow diverticulum in which case it should be opened ligated and excised.

As a rule the sac is inverted by means of a purse string suture and the floor of the canal is inverted by interrupted sutures of fine silk or cotton. Finally, this new posterior wall is further reinforced by a second row of interrupted sutures that further invert the floor of the inguinal canal to make it strong and firm. If the hernial opening is large it is often advisable to suture the fascial edge to the fasci of the inguinal ligament with interrupted stitches of fine silk or cotton (Figs 103 and 104). Andrews (F) was one of the first surgeons to point out the importance of suturing fascia to fascia and not to red muscle.

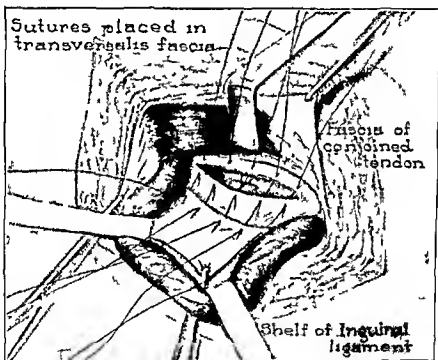


Fig. 104—Operation for small direct inguinal hernia. Suture of transversalis fascia to the inguinal (superficial) ligament.

Direct hernia is really a ventral hernia. The only thing it has in common with the indirect type is that both of them make their exit through the external inguinal ring.

**Hoguet's Operation**—After exposing the hernia by the usual incision the indirect sac which is always present is located separated from the cord and opened. The deep epigastric vessels are not divided. By traction on the oblique sac the direct sac is drawn to the outer side of the deep epigastric vessels and the two sacs are converted into one before opening. There is much less danger of

wounding the bladder when this is done than when the direct sac is opened internal to the epigastric vessels. (Figs. 105-106.)

Tanner described a "slide" operation that has given good results in direct inguinal, recurrent, and strangulated hernias. Briefly, it is a slide downward and laterally of the lower rectus sheath and conjoint tendon to reinforce the posterior wall of the inguinal canal or to close the entrance to the crural canal,

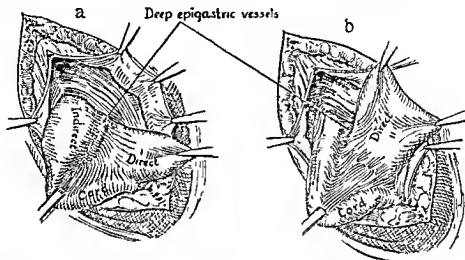


Fig. 105.—Combined direct and indirect inguinal hernia. (a) Direct and indirect hernial sac exposed. (b) The indirect sac converted into a direct sac.

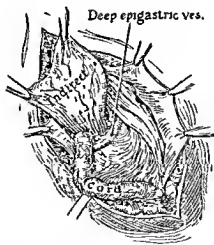


Fig. 106.—Combined direct and indirect inguinal hernia. The direct sac has been converted into the indirect variety. This is the safest way to deal with a direct sac on account of the proximity of the bladder.

and therefore it is a modification of the Bassini and Lotheissen operations. The method is especially adapted to certain direct hernias and indirect hernias where a posterior repair is indicated for a large internal inguinal ring. dell'Oro also used a slide operation. Employing a transverse abdominal incision, he sutured the rectus sheath to Cooper's ligament. Mattson also turned down a flap from the anterior rectus and pyramidalis fascia and sutured it to Cooper's ligament.



**Short Median Cosmetic Incision for Hernia Operation**—For small reducible hernias in females Morcstin made a vertical incision  $1\frac{1}{4}$  to  $1\frac{1}{2}$  inches (3.4 cm) long in the midline in the mons veneris just above the os pubis and down to the aponeurosis. The wound is retracted to a point over the inguinal canal, the hernia exposed and the operation carried out in the usual manner. When the wound has healed there is a very small scar which is completely covered by the pubic hair.

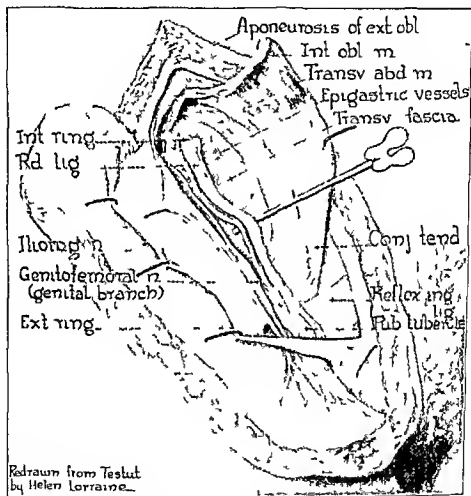


Fig 107—The inguinal canal in the female

Winter described a similar operation as follows. A 3 inch (7.5 cm) median incision is made just above the pubes through the skin and superficial fascia. The incision is retracted to one side the aponeurosis exposed over the inguinal canal incised and the usual operation done. The incision is then retracted to the opposite side and the second hernia repaired, finally closing the subcutaneous tissues and skin.

**Short Oblique Incision for Inguinal Hernia Operations**—Many Italian surgeons use a very short oblique incision made between the superficial cir

cumflex iliac and the superficial epigastric vessels. No vessels are tied, and the inguinal canal is exposed by retracting the small opening in different directions.

**Inguinal Hernia Operation in the Female**—It is easier to cure inguinal hernia in the female than in the male because there is no cord to prevent complete closure of the internal ring and the inguinal canal. I have found that the best plan is to leave the round ligament undisturbed and include it in the deep sutures (Fig 107). Lucas Championniere removed the sac, excised the round ligament and overlapped the flaps of aponeurosis. Kelly transplanted the round ligament and did not remove the sac if it was small. (I might remark here that hydrocele of the canal of Nuel is sometimes difficult to distinguish from hernia.)

**Method of Removing a Very Adherent Sac**—I have observed that when it is difficult to remove the sac the dissection can be facilitated by filling the sac with strips of gauze to outline its walls.

**Position of Patient During Operation**—After the deep sutures are placed the wound is kept relaxed by elevating the shoulders and flexing the thigh. This position, which I have found especially valuable in direct and large recurrent hernias, should be maintained as long as the patient is kept in bed.

### Transplantation of Fascia Lata in Hernia Operations

Kirschner reinforced the hernia operation by securing a strip of fascia lata from the thigh. The strip of fascia should be longer than the area to be covered and 2 to 3 inches (5 to 7.5 cm) wide. This 'free' transplant is cut off and tacked over the line of suture of the aponeurosis of the external oblique. According to Kirschner, the advantages of fascia lata are its necessity, abundance, strength, inelasticity, its readiness to heal in when transplanted and it can be cut to fit an opening of any shape (Figs 108 and 109).

After considerable experimental study, Gallie and Le Mesurier found that the best results followed the use of fascia lata in the form of narrow strips six or seven inches (15 to 17.5 cm) long and one quarter inch (6 mm) wide. These strips are threaded upon a curved large eyed needle and woven into the edges of the surrounding muscles and aponeurosis, much as a sock is darned.

Masson has devised a fascial stripper which shortens the time required for an operation using fascia lata strips as suture material. The stripper is introduced through a short incision on the outer side of the thigh, the inner tube threaded with the fascial strip and pushed down until the desired length of fascia is secured. This is cut off by pushing down the outer tube which has a cutting edge. Thus a long strip of fascia can be cut into three or four sutures. I have found that many patients object to the small incision necessary to secure fascia lata from the thigh. Collins (D. C.) and Clark and Hashimoto have published excellent papers on the technique of the application of fascial sutures.

Burdick, Gillespie, and Higginbotham reported 1485 operations on 1092 patients in which fascial sutures were used. Infections were more common than with other sutures; two patients died from hemorrhage caused by the needle; a recurrence rate of 29 per cent was partly the result of weak spots produced by

the large fascial needle. At reoperation no evidence was found of the fascia sutures so the method was abandoned in favor of a silk and cotton suture.

Many surgeons who formerly depended on fascial sutures or grafts have abandoned this method in favor of the simpler Cooper's ligament operation which gives equally favorable results even in recurrent inguinal hernia operations once the surgeon becomes experienced in the technique. The important step is emphasized by Swenson and Harkins is to prevent any tension on the deep sutures by making a relaxing incision in the internal oblique aponeurosis near the midline where it joins the anterior rectus sheath. This relaxing incision extends from 1 inch (2.5 cm) above the symphysis pubis upward for 3 to 4 inches (7.5 to 10 cm).

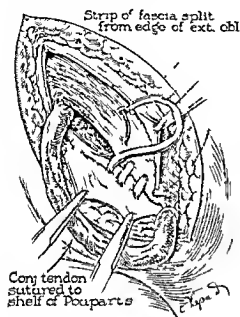


Fig 108

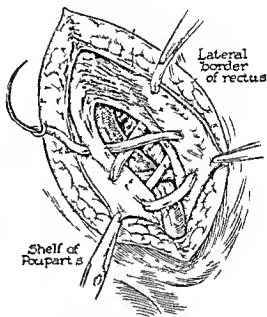


Fig 109

Fig 108—The use of fascia lata as continuous suture operation for inguinal hernia

Fig 109—Fascia lata used as interlacing suture for inguinal operation

**Disadvantages of Fascia Sutures**—Fascia sutures present certain shortcomings that are not found in the fascial patch. There is a tendency among surgeons, however, to rely more and more on the skillful application of silk and cotton stitches in repairing large and recurrent hernias.

The surgeon experienced in the use of silk and cotton sutures in simple and difficult hernias apparently secures as good results as the operator who depends upon fascia sutures. Swinton and Sanderson of the Iliac Clinic in 1941 reported 242 herniorrhaphies with silk suture and cite the following objections to fascia operations: induration in the abdominal wound; a defect in the thigh when the fascia lata wound was not closed; and when closed, discomfort from the tightening that often causes criticism. This bears out the observations of Wakeley who reported a large number of fascia operations on recurrent hernias.

World War II It was necessary to invalid many of the men home from the fighting forces because they complained of pain in the outer surface of their thighs where fascial grafts had been taken months previously by some fancy fasciotomy.

Zimmerman also pointed out the following disadvantages of fascia sutures (1) the strips are thick and heavy and require very large needles with their attendant trauma (2) the technique is difficult and cumbersome, (3) an added operation is required to procure the strips from the thigh and the defect there often causes discomfort.

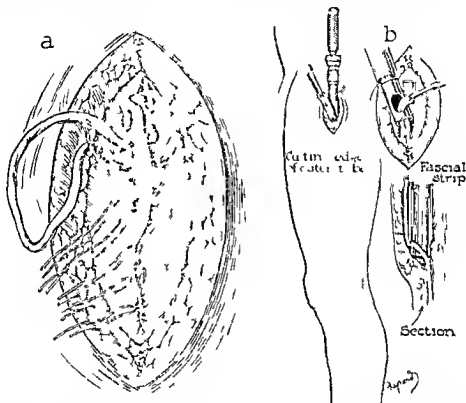


Fig. 110—Hernia operation with fascia lata sutures. (a) Overlapping the fascial flaps. Fine silk is used for the preliminary mattress sutures. (b) Method of securing fascia lata flaps with Macon's fascia stripper.

### The Fascial Patch

The fascial patch has certain advantages over the fascial suture. The patch can sometimes be secured from the external oblique fascia, it is easier to use than fascia stitches. In obese patients there is less constriction of the abdominal contents, there is no increase in intraabdominal pressure with its danger of pulmonary complications, the operation is shorter and less complicated than the fascia suture method, it requires less handling of tissues, there is minimum danger of injury to blood vessels and nerves.

**Technique for Applying the Fascial Patch**—Small patches can occasionally be secured from the aponeurosis of the external oblique muscle. As a rule, it is more satisfactory to secure a patch of fascia lata shaped to fit the

hernial defect from the middle of lower third of the lateral aspect of the thigh. The patch is trimmed and notched to fit snugly around the spermatic cord at the internal inguinal ring (Fig 111). No fatty or loose areolar tissue should be left in the wound where the patch is to be fitted. With the patch in position it is firmly anchored in place with interrupted sutures of fine silk or cotton to the lacunar and inguinal ligaments below. Next the upper edge of the patch is tucked well up under the conjoint tendon, transversalis fascia and internal oblique muscle, and fixed with interrupted stitches of fine silk or cotton.

The transversalis and internal oblique fascia are sutured over the fascia patch, but under the cord, to the inguinal and Cooper's ligament, with interrupted stitches of silk or cotton (Fig 112).

The operation is completed by uniting the aponeurosis of the external oblique to the inguinal ligament over the cord, and the skin incision is closed. Interrupted sutures of fine silk or cotton are used throughout.

Gould sutured a broad patch of fascia over the fascia strips used for the deep sutures, and aptly termed it "patching the darned hole."

Pérez Fontana described an excellent flap operation. After uniting the transversalis fascia and conjoint tendon to the inguinal ligament, he secures a strip of fascia from the inner leaf of the aponeurosis of the external oblique and sutures it over the cord to the inguinal ligament, then imbricates the aponeurotic flaps over the fascia patch. The wound is then closed in the usual manner with interrupted sutures.

Zimmerman suggested reinforcing the suture line with a fascial patch or a strip of fascia from the outer leaf of the aponeurosis of the external oblique to strengthen the transversalis fascia. The internal oblique muscle is separated from the transversus layer and held upward with a retractor, while the aponeurotic flap is sutured down to the transversalis fascia. The internal oblique is then permitted to drop back into its normal position, covering the suture line like a trap door. No sutures are placed in the internal oblique muscle. The fascial edge is sutured to the inguinal ligament and the free flap of fascia is stitched down so as to imbricate the fascia, and the wound is closed. Interrupted sutures of fine silk or cotton are used throughout the operation.

Williamson, in 1941, reported 163 elective hernia operations with fascia graft, and a recurrence rate of 1.3 per cent in indirect inguinal hernias and 8.3 per cent for direct inguinal hernia in men. Singleton and Stehouwer, in 1945, stated that in 129 patients with large hernias the fascia patch was used with local anesthesia. There were only 14 recurrences in this series.

**The Fascia Flap Operation**—This method was used by Beach in 300 inguinal hernia operations with a very low recurrence rate. He made the skin incision well to the medial side of the internal inguinal ring, lifted a large square shaped flap from the aponeurosis of the external oblique, turned it back, and ligated and excised the hernial sac. The reflected flap is then passed under the cord, drawn into its former position, and sutured. The wound is closed in the usual manner. Fernandez de Castro also starts the skin incision well to the inner side of the internal inguinal ring so as to give a better exposure of the transversalis and rectus fascia.

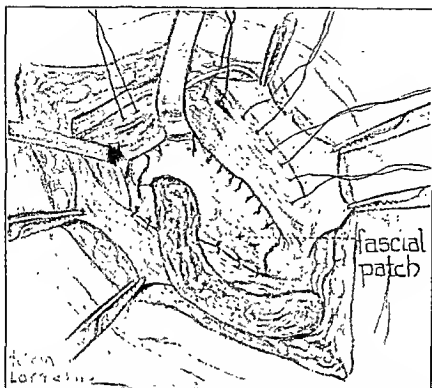


Fig. 111.—The fascial patch. The patch is notched to fit snugly around the cord at the internal ring. The lower edge is anchored to Cooper's, the lacunar, and the inguinal ligaments.

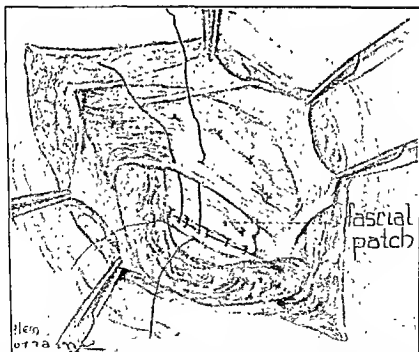


Fig. 112.—The fascial patch. The upper edge of the patch is tucked up under the conjoined tendon, transversalis fascia, and internal oblique muscle, and fixed with interrupted sutures. The transversalis and internal oblique fascia are sutured over the patch, under the cord, to Cooper's and the inguinal ligaments.

### The Cutis Graft Patch

The cutis graft is readily available and may be used instead of fascia or tendon patch or graft. After the hernial sac has been dissected out and ligated the fascial edges are brought together as well as possible with interrupted sutures of medium cotton or silk. A graft is taken from the wound flaps or from the anterior external surface of the upper third of the thigh. The epidermal layer is cut away with a skin graft razor. Then the skin graft is cut and shaped to fit the hernial defect and securely sutured with interrupted fine silk or cotton stitches. The fat should be removed as well as possible from the graft. It is important to close the wound carefully and to leave no dead spaces or pockets which might increase the danger of infection. The subcutaneous tissues and skin are closed in the usual manner. (Fig. 113.)

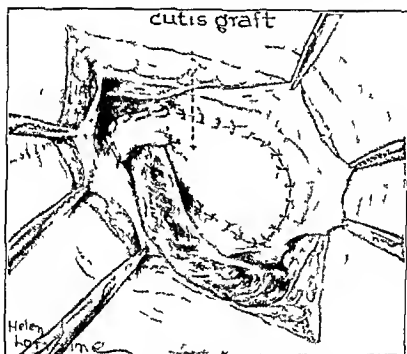


Fig. 113.—The cutis graft patch. The skin graft is cut and shaped to fit the hernial defect. It should fit tightly around the cord and be firmly sutured to the fascia above and to Cooper's or the inguinal ligament below.

Cannaday, who has had extensive experience with this method, cites the advantages of the cutis graft as follows: it heals rapidly and well; it is strong and stable from the time of operation; it has great viability and is able to survive under adverse conditions; it possesses marked tensile strength; it has a good blood supply; it assumes the function of the part it replaces as it is gradually converted into fibrous tissue.

Mann reported 137 hernia operations with the cutis graft. Swenson and Harkins have had good results with the cutis graft in large hernias.

### Other Operations

**Floss Silk Lattice Repair**—Floss silk lattice repair has been employed in 500 cases by Maingot with good results for direct hernia. Brigadier Edwards remarks that in the hands of Maingot the results have been good. Other surgeons have not been so fortunate even though the immediate results are good, many patients turn up months later with sinuses in the hernia repair that open and drain. Tantalum mesh has been used with success for large hernias.

**Intraabdominal Operation for Inguinal Hernia**—This method was used extensively by LaRoque with good results. Jacobson has improved on the technique proposed by LaRoque for hernias not due to a deficiency in the fascium of the transversus abdominis.

**Abdominal Operations Through the Hernia Incision**—Extensive abdominal or pelvic operations that necessitate enlarging the hernial opening should not be attempted because of the difficulty in closing the hernial ring tight. The better plan is to complete the hernia operation, then make a midline or lateral rectus incision for the other operation.

**The Removal of the Appendix Through the Hernia Incision**—It is possible to remove the appendix through the hernial incision. I believe, however, that no attempt should be made to remove the appendix unless there is a history of attacks of appendicitis, or the appendix is large and readily palpated through the right internal ring, and the cecum freely movable and easily drawn down into the wound.

Occasionally the appendix is in the hernial sac and it may be inflamed, gangrenous, or the site of an abscess. When an infected appendix is removed through a hernia incision I always make a stab drain in the appendix region.

One of the best combined operations for appendicitis and hernia was described by Torek, as follows. The usual skin incision for hernia is extended as far as the anterior superior spine of the ilium and the aponeurosis is split from the external ring outward and upward, separating at the upper end the fibers of the external oblique muscle for a distance of 1 to 1½ inches (2.5 to 4 cm). The flaps are retracted, the internal oblique and transversalis muscles split in the direction of their fibers, the peritoneum is exposed and opened, and the appendix removed and the wound closed. The hernia operation is carried out according to the technique already described. Morrison begins the incision 1 fingerbreadth above the internal inguinal ring, and limits the hernio appendiceectomy to children and young adults. Belcher Costa advocates the routine removal of the appendix when operating for right inguinal hernia.

**Elephantiasis Complicating Hernia**—Elephantiasis is not an uncommon complication of inguinal hernia in tropical or semitropical countries. The best procedure is to operate on the hernia first, then deal with the elephantoid scrotum. This is done, provided the hernia is small. Large irreducible hernias when complicated by elephantiasis are dangerous operative risks because of the danger of cardiac or pulmonary complications following the increase in intra-abdominal pressure when the viscera are returned to the abdominal cavity.



## OPERATIONS FOR HERNIA AND UNDESCENDED TESTIS

The testis may be found in any of the following locations in the abdomen, at the internal ring, in the inguinal canal, below the external ring in the perineum in the femoral region or it may be interparietal (in the abdominal wall)

When the testis is as high as the internal ring it is usually advisable to place it in the abdominal cavity when it is in the inguinal canal or beyond the external ring it can almost always be brought down into the scrotum

In early times the surgeons removed the testis. The testis is no longer sacrificed. Its importance to the future development of the patient from an endocrine standpoint is recognized and an effort is always made to preserve it and to place it in the scrotum if possible. If this cannot be done it should be replaced in the abdominal cavity.

Pannett stated that when the testis is replaced in the abdominal cavity its secretory function is not interfered with but there will be no spermatogenesis as the seminal tubules are unable to secrete on account of the high intraperitoneal pressure.

Operative treatment is seldom indicated in children under four years of age. The best treatment for these little patients is massage and traction on the cord and testis to favor descent. Operation is most satisfactory when the patient reaches the age of ten or twelve years. At times anterior pituitary extract give good results and occasionally small doses of testosterone propionate may be administered once a week for a short period of time. The latter drug is dangerous and often causes marked enlargement of the prostate in young boys.

A truss should not be fitted to a hernia associated with undescended testis unless it can be done without making the least pressure on the testis. If it is impossible to separate the testis and the hernia operative treatment is usually advisable.

The most favorable age for operation for undescended testis is between the tenth and twelfth years. In very young children the testis and cord structures are so small and delicate that it is difficult to handle them without injury. If the operation is delayed beyond the twelfth year the development of the testis is retarded and it is more difficult to bring it into the scrotum. McKenna states that the most favorable age for operation is from the fifth to the ninth year.

Many operations have been devised to hold the testis in the scrotum. Monod and Richelot sutured the cord to the pillars of the external ring. Cheyne and Tuffier caused traction to be made on the testis from a distance. Bérard sutured the cord to the tunica vaginalis testis and Ombredanne carried the testis to the opposite side of the scrotum and fixed it there with a suture. Tomlin has reported good results in 85.7 per cent of all patients treated by the Ombredanne operation.

**Bevan's Operation**—The best operation for undescended or maldescended testis is the one devised by Bevan in 1899. The incision through the skin sub

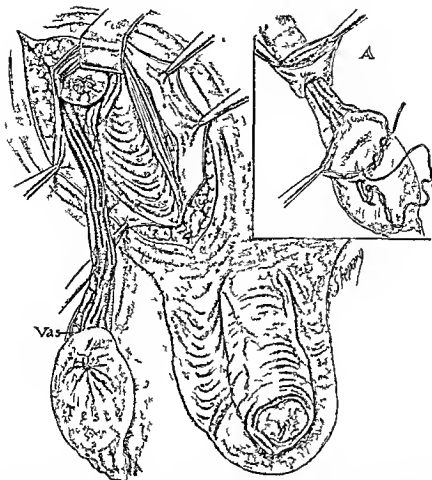


FIG 114A.—Bevan's operation for undescended testicle. The cord is lifted out of its bed and the fascial bands which are seen in the cord are loosened, all the surrounding fascia is stripped from the cord leaving only the vessels and vas deferens. It is seldom necessary to divide the spermatic artery and veins. (A) Suture of the tunica vaginalis testis over the testicle.

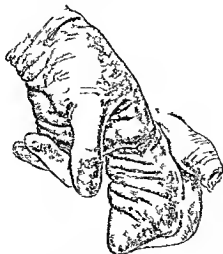


FIG 114B.—Bevan's operation for undescended testicle. A pocket for the testicle is formed in the scrotum by blunt dissection.

cutaneous tissues and aponeurosis of the external oblique is made just as for a hernia operation. The cremaster muscle and transversalis fascia are incised and the sac is separated from the cord. The sac is very thin and is easily torn especially in children. It is divided and the upper portion ligated and excised; the lower portion is treated the same as in congenital hernia in which the sac communicates with the tunica vaginalis. The portion of sac lying in contact with the testis is sutured over it.

The testis is lifted up out of its bed, the cord lengthened as much as possible by gentle traction and at the same time the fascial bands which are seen in the cord are loosened; all the surrounding fascia is stripped from the cord leaving only the vessels and the vas deferens which lie behind the posterior layer of the peritoneum and they are separated from it by blunt dissection.

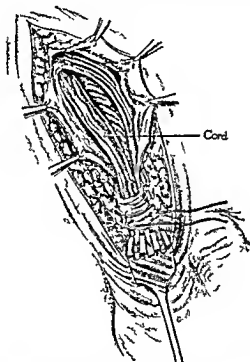


Fig. 115.—Deans operation for undescended testicle. The testicle is placed in the newly formed pocket in the scrotum and a purse-string suture is placed in the inguinal ring in such a way as to avoid making pressure on the cord. This stitch prevents the testicle from entering the inguinal canal or being displaced above the ring on the aponeurosis.

The vessels pass upward and inward and the vas deferens passes downward and inward from the external ring. After the vessels and vas deferens are carefully freed it is usually possible to bring the testis down into the scrotum three to four inches (7.5 to 10 cm.) below the external ring (Fig. 114A). If the testis does not come down it may be necessary to divide the spermatic artery and veins between ligatures to secure sufficient lengthening of the cord. Bevan has found that this was necessary in only about 10 per cent of his cases.

Next a pocket is formed in the scrotum by blunt dissection (Fig. 114B), the testis placed in it and the upper part of the pocket closed by a purse-string

suture which is passed through the dartos and placed in such a way as to avoid making pressure on the cord. This suture prevents the testis from entering the inguinal canal or being dislocated above the ring on to the aponeurosis (Fig 115). The wound is closed without transplanting the cord or suturing the testis in the scrotum.

**Results Following the Bevan Operation**—Coley and Hoguet reported 441 cases in which the Bevan operation was employed with the following results: there was not a single case of gangrene of the testis; in the majority

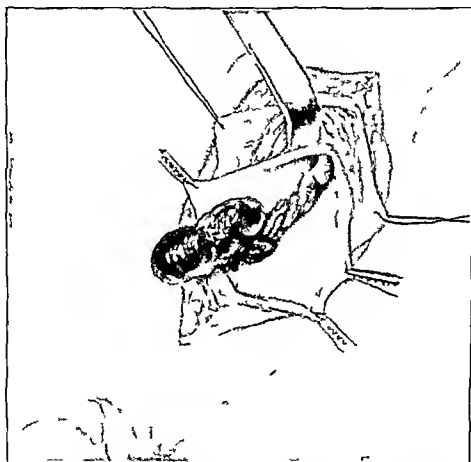


Fig 116—Torsion of the cord and strangulation of the testis with four complete twists of the cord

of cases the testis remained in the lower or middle part of the scrotum and in a number of cases it was near the external ring when the testis was normal at the time of operation it continued to develop; atrophied testes did not grow after operation.

A few cases of gangrene of the testis following the operation in which it was necessary to divide the spermatic artery have been reported in the literature. I believe these bad results may be avoided if the tissues are handled very gently throughout the operation.

Calverley pointed out that before operating on patients with small testes, their attention should be called to the condition. If the small testis was accidentally discovered later by the patient, he would blame it on the operation.

**Results Following Operation for Undescended Testis and Hernia**—The results following operation for undescended testis and hernia are much better in children than in youths or adults. Coley stated that no recurrence of hernia had been observed in 314 operations for undescended testis and hernia.

**Torsion of Testis and Hernia**—Torsion of the testis and cord are rarely due to a co-existing congenital inguinal hernia. I recall a boy of five years that I operated on for strangulation of the left testis. There were four complete twists of the cord and the testis was dark and swollen. The cord was straightened, hot compresses were applied, and the testis was saved. (Fig 116) Bennett Jones has admirably reviewed the literature on the subject.

**Inguinoperineal Hernia**—Inguinoperineal hernia is due to maldescent of the testis into the perineum. The sac is freed and treated as in congenital hernia. A new tunica vaginalis is formed from the lower portion of the sac. If the cord is short, it is not transplanted and the testis is placed in a new bed in the scrotum as described in Bevan's operation. Rea has written at length on the fate of the perineal testis.

**Newgrowths in the Undescended Testis**—Newgrowths in undescended testes are rare. Cunningham collected from the literature 452 cases of tumors of the testes, in 40 of these, the testis was imperfectly descended. Lipshutz has made a careful study of the pathology of tumors of the undescended testis.

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## CHAPTER XVII

### GENERAL TREATMENT, ACCIDENTS AND COMPLICATIONS

#### PREOPERATIVE CARE

**Simple or Uncomplicated Cases.**—The average patient with nonstrangulated inguinal hernia comes to operation in good condition and requires little preliminary treatment. He should however, spend the night preceding operation at the hospital to become accustomed to his bed and to receive whatever preparatory treatment is necessary.

A mild cathartic is usually administered the night before and a low enema is given the morning of the operation. Drastic purging and repeated enemas are not only unnecessary but actually harmful as they diminish the "tone" of the intestines and predispose to postoperative intestinal paresis and gas pains. It is very important for the bladder to be emptied just before the operation.

**Wound Healing.**—There are certain measures that hasten wound healing and aid in a prompt recovery. A low ascorbic acid and plasma level calls for a week's preoperative treatment, with daily doses of 1,000 mg. of ascorbic acid, with vitamin B complex, preferably intravenously or intramuscularly, transfusion for a low blood cell count, and a high caloric diet of proteins, fats, carbohydrates, and fluids.

It is expensive and impractical to test each patient for ascorbic acid and vitamin deficiency; therefore, the usual plan is to carry out the routine administration of ascorbic acid and vitamins for all patients.

**Complicated Cases.**—The dangers of operating on large irreducible hernias in obese patients and the complications that may occur in patients with cardiovascular renal or pulmonary disease, are taken up in the section on prognosis.

The preliminary treatment of irreducible scrotal hernias that have lost their *right of domicile* in the abdominal cavity is the same as that for irreducible umbilical hernias and is described in the chapter on umbilical hernia. The object of this preliminary treatment, which requires two to six weeks' time or longer, is to reduce the intraabdominal fat so that the hernia can be reduced with as little increase as possible in intraabdominal tension, thereby lessening the danger of cardiovascular and pulmonary complications.

Patients suffering from advanced pulmonary disease should never be operated on for hernia except in case of strangulation. Bronchitis or a cough of any kind should be cured before operation as the recumbent postoperative position favors the development of hypostatic congestion of the lungs or pneumonia and the persistent coughing favors the recurrence of the hernia.

Before operating on large or only partially reducible hernias, the intestines must be thoroughly emptied to decrease intraabdominal tension as much as possible.

**Sliding Hernia**—When it is difficult to locate and free the sac, especially in large hernias, sliding hernia of the large intestine or bladder is always to be thought of. Sliding hernia on the right side usually involves the cecum and appendix, and on the left side it involves the sigmoid. A portion of the bladder may be included on either side, and rarely it may be the sole content of the hernia. (For additional details see chapter on sliding hernia.)

## ANTISEPTICS, NEEDLES, AND SUTURES

**ANTISEPTICS FOR THE SKIN**—The best antiseptic is tincture of mercuric iodine (stainless). Iodine should not be used, as some patients have a decided idiosyncrasy for iodine. There are other antiseptic solutions that equal it in germicidal power and do not blister and irritate the skin.

Another good antiseptic which also contains a fat solvent, is McDonald's solution, consisting of acetone 40 parts alcohol 60 parts to which is added pyrol 2 parts.

**NEEDLES**—I use a full curved round pointed needle for all the sewing except for the skin. Some operators use a full curved cutting point Hagedorn needle for all the suturing. De Garmo used a round full curved cervix needle  $\frac{1}{4}$  inch (2 cm) long, with the point filed off. (For additional information, see the chapter on general considerations.)

### SUTURES—

**The Silk Suture**—Silk is the most generally used of the nonabsorbable suture materials. It was popularized by Halsted in the early nineties and has come into use by a majority of surgeons in recent years. It has certain advantages over cotton: it is stronger, and easier to handle in suturing and ligating, blood vessels, smaller sizes can be used than with cotton, boiling does not destroy its tensile strength as in the case of cotton.

To secure the best results with silk there should be careful preoperative skin preparation, only the smallest sizes of sutures should be employed, all stitches should be interrupted and never continuous, tissues must be handled gently, tight sutures and mass ligation should be avoided, silk and catgut sutures should never be combined, stitches should be placed not closer than  $\frac{1}{2}$  inch (1 cm) apart and the ends of the knot should be cut very short.

**The Wire Suture**—Fine alloy steel wire is the favorite suture of many surgeons. With it, Babcock has secured outstanding results: a minimum of infections and a very low recurrence rate in large hernias. He emphasizes the importance of tying the wire in a square knot and cutting the ends very short. He never uses silver wire as it breaks and fragments. There is practically no tissue reaction to steel wire, less than with any other suture material, and it has far more tensile strength than any other suture.

**The Cotton Suture**—The cotton suture is efficient, inexpensive, and always available. Although it has less tensile strength than catgut, silk, or linen, it is easy to work with once the surgeon becomes accustomed to it. The size of the cotton thread is not important as long as its tensile strength is greater than the tissues stitched together. Flax, in 1946, published an excellent review of the

history of the cotton suture. He prefers No. 50 cotton using it for all layers of the abdominal wall. For the deep stitches he simply doubles the thread. Thorek followed Taylor's suggestion and used No. 24 cotton for all the layers from peritoneum to skin. I prefer to use various sizes of thread for the different layers. Thorek believes that cotton is much less irritating than silk and can be used in infected wounds without danger of a sinus developing, as there is no infiltration of leucocytes into cotton as occurs with silk or linen. Maier has had a similar experience.

Meade and Ochsner unbedded the various materials in living tissue for ten days then tested the tensile pull. The cotton sutures were still 100 per cent, while the other sutures lost tensile strength: silk 25 per cent, linen 40 per cent, and catgut 70 per cent. Ochsner has stressed the advantages of cotton.

Cotton is preferably sterilized by boiling for twenty minutes. It should be wrapped on a rubber or gauze spool. The wooden spool expands in water and the cotton shrinks so there is danger of fraying or breaking the cotton fibers. Autoclave sterilization weakens the cotton thread, and whatever is left over from the operation should be discarded as the cost is less than five cents for each operation. Cotton loses much of its tensile strength if boiled more than once. Rogers prefers cotton because the knot does not slip as sometimes happens with silk.

### ACCIDENTS DURING HERNIA OPERATIONS

**1 Injury to the Intestine**—The intestine is sometimes incised by mistake for the sac especially in sliding hernias. Occasionally intestine is in the sac and is not recognized or is mistaken for omentum.

An accidental incision of the intestine should be repaired immediately by Lambert sutures or if the opening is very small a purse string suture will be sufficient. A second running stitch is used to reinforce the first row, and finally, a piece of omentum should be tacked over the wound to prevent leakage and adhesions.

A loop or knuckle of intestine may be caught in the ligation of the sac. This accident can always be avoided if the sac is opened even though it is very small and carefully examined before ligating; its interior should also be inspected after ligating before cutting off the sac.

**2 Injury to the Bladder**—The bladder is liable to be wounded in any operation for hernia. In direct hernia the mucous wall of the sac is often in contact with the bladder which may be injured unless great care is taken in freeing and ligating the sac. If the bladder wound is recognized and carefully closed there is little danger. The serious cases are those in which a portion of the bladder is excised by mistake for the sac or when the viscus is penetrated by the needle during the closure of the wound and the accident not recognized until several hours later when the symptoms of peritonitis appear. (For further details see the chapter on hernia of the bladder.)

A persistent urinary fistula may follow injury to the bladder necessitating a subsequent operation to close it. If a suspicious looking 'cyst' is en-

countered during operation the possibility of its being bladder can be excluded by one of the following methods injecting methylene blue solution into the bladder, distending it with air or water passing a sound into it and palpating the tip in the wound and by aspirating the "cyst" with a fine hypodermic needle and testing the fluid for urine

**Position of the Bladder in Infants and Children**—In infants and young children the bladder is situated higher than in older children. This point must be borne in mind so as not to mistake the bladder for the hernial sac.

**3 Injury to the Vas Deferens**—The vas deferens can be recognized by its hard cordlike feel. It is often intimately adherent to the sac in complete congenital hernia and dissection may be difficult. Care must be taken not to incise or divide it. If it is accidentally divided it should be repaired by passing a fine plain catgut suture into the lumen of each cut end and then out through the wall, tying a knot in each end of the suture approximates the divided ends. (Fig 117.) A better method is to cut off the ends obliquely and do an end to end suture by using a very fine No. 16 chromic needle threaded with silk such as is used in blood vessel repair.

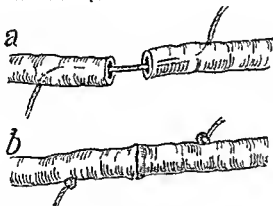


Fig 117—Method of repairing the divided vas deferens by passing a plain catgut thread through the lumen of each end and tying a knot in each end of the thread.

**4 Injury to the Spermatic Artery**—The spermatic artery can be located by feeling its pulsation in the cord. It should never be unnecessarily divided as cases are on record in which atrophy or necrosis of the testis has followed the severing of this artery. Griffiths Bevan and others have shown that the artery of the vas deferens is usually sufficient to prevent atrophy or gangrene of the testis.

**5 Faulty Ligation of Sac**—The sac should never be ligated without first transfixing its neck in order to prevent the ligature from slipping. Faulty ligation may be followed by a slipping of the ligature before the deep sutures are placed and the escape of intestine and omentum through the opening if the ligature slips after the deep sutures are inserted it leaves a depression at the internal ring which predisposes to a recurrence.

**6 Injury to External Iliac Vessels**—While injury to the external iliac artery or vein is rare the possibility of it should always be remembered when passing the sutures through the edge of Cooper's or the inguinal ligaments.

To avoid this accident, the shelving edge of the inguinal ligament should be well exposed, and care exercised not to take too deep a bite in it.

In operating for recurrent hernia, especial care must be taken to avoid the external iliac vessels, which are sometimes very superficial on account of the thinning out of the inguinal ligament. The needle should be guided through the shelving edge of the inguinal ligament by the tip of the index finger, or the finger can be placed to the outer side of the inguinal ligament and the iliac vessels depressed as the needle is passed through the shelving edge. It is a serious accident to injure the vessels. When it happens, it is necessary to expose the vessel and suture the rent using a No. 16 cambrie needle threaded with human hair or the finest silk suture coated with petroleum jelly. Every surgeon should have these needles and sutures in his instrument bag at all times.

Ranson reported a needle puncture of the iliac artery during an operation, by another surgeon, for recurrent inguinal hernia. Hemorrhage continued for three weeks until operation was undertaken for arteriovenous aneurysm and both artery and vein were ligated above and below the injury. Later amputation was required just above the knee.

In 1,000 operations for inguinal hernia, O'Connor wounded the external iliac vein in two patients while putting in the deep sutures. In both instances he was using a sharp curved needle. In one case amputation of the foot was required, in the other the wound in the vessel was sutured without any after effects. Sometimes continuous pressure for two hours will check venous hemorrhage.

Ligation of the femoral or iliac artery is usually followed by gangrene of the extremity, and the procedure is not only dangerous but exceedingly difficult. Babcock advises if blood spurts from the needle puncture, simply tying the suture which arrests the hemorrhage, and continuing with the operation. However should the puncture be made with a large fascial suture needle, the above maneuver will not suffice and arterial suture will be necessary.

**7 Injury to the Deep Epigastric Vessels**—The deep epigastric vessels are easily tied if wounded unless the injury is inaccessible and located near the origin of the deep epigastric artery from the external iliac artery, when it is necessary to treat it the same as an injury of the external iliac artery, which has just been described. Erdmann reported a case in which he accidentally severed the deep epigastric artery at the point where it leaves the external iliac artery. To control the hemorrhage he was compelled to suture the rent in the external iliac artery. He believed the accident was due to the use of a cutting edge needle.

Allen said that while operating on the second side of a double hernia he noticed blood in the abdominal cavity. He reopened the first wound and found a small bleeding vessel in the peritoneum just above the neck of the sac.

## POSTOPERATIVE COMPLICATIONS

The postoperative complications following a hernia operation are similar to those following other abdominal operations. Complications direct or indi-

rect, occur in 10 to 20 per cent of all hernia operations under general anesthesia. The pulmonary complications are greatly reduced by local anesthesia. Gibson and Felter reported, 1,878 hernia operations on 1,618 patients with the following complications: bronchitis 32, pneumonia 34, cough 30, influenza 1, infarct 8, embolism 1, empyema 1, pulmonary tuberculosis 5, laryngitis 1, skin dermatitis 6, infective diseases 21, infected wound 70, orchitis and epididymitis 21, spermatocele 1, hydrocele 74, varicocele 23, hematoma 59. Accidents at operation were: vas cut and repaired 2, bladder opened 2, cord cut, testis excised 1, sigmoid nicked 1, artery wound 1.

Beckman and Sullivan reported 2,000 hernia operations with 321 postoperative complications, 16 per cent. Fallis reported 1,600 hernia operations with complications developing in 116 patients as follows: bronchopneumonia 14, bronchitis 7, atelectasis 6, pulmonary embolism 3, lobar pneumonia 1, pulmonary infarct 1, lung abscess 1, wound infection 16, hydrocele 14, hematoma 13, atrophy testis 1, phlebitis 3. In 800 cases there was 8.2 per cent recurrence, indirect 7.4 per cent, and direct 11.6 per cent recurrence. Complications encountered in tropical countries are: elephantiasis, chylocele and filarial lymphangiectasis.

All of the above quoted complications, especially the pulmonary group, are much reduced at the present time with the general adoption of early rising after operation, etc. A general decrease in complications is well expressed in the wise words of the noted Argentine surgeon, Professor Ivanussievich, who remarked "the whole progress of our art consists of technical improvements."

**Respiratory Complications After Hernia Operation.**—Early rising following hernia operations markedly reduces the frequency of respiratory and other complications. Lucas studied the postoperative complications of 438 unilateral inguinal hernia operations from the point of view of postoperative respiratory complications. He found that anesthetics that depress the respiration are unsatisfactory, and that patients with a history of an upper respiratory infection operated on within three weeks had a higher incidence of postoperative respiratory morbidity. The lung on the same side as the hernia was most often affected. Lucas believes this is accounted for by the pain on that side and the resultant hypoventilation after operation, due to diminution in the movement of the diaphragm, with blocking of the bronchioles with mucus on account of the pain that accompanies coughing.

Chemotherapy was without effect on the symptoms except to lower temperature. Immediately following operation, and preoperatively if possible, breathing exercises are instituted to expand the base of the lungs. These are repeated every four hours for the first forty-eight hours postoperatively. After this period they are done twice daily with the addition of abdominal and leg exercises.

McLaughlin and Brown, in 1946, in a series of 1,407 hernia operations on Naval recruits, observed pulmonary complications in 2.4 per cent of the men, usually atelectasis, lobar and lobular and bronchopneumonia.

**Effect of Sutures on Temperature and Pain**—Silk and cotton sutures are much less irritating to the tissues and cause less systemic reaction and fever than do catgut sutures. This is strikingly demonstrated by the studies of Zollinger and Lynn who compared a series of cases in which catgut had been used to a group in which the wound had been sutured with cotton. The advantages with cotton stitches was strikingly demonstrated.

1 Less postoperative induration occurred and it resolved more rapidly with cotton sutures.

2 Patients whose hernias were repaired with catgut usually required narcotics to control pain while those with cotton repaired wounds were able to rest with milder sedatives.

3 Postoperative temperatures ranged higher in the patients who had catgut suture of the wounds.

**Allergy to Catgut Suture Material**—Many patients are allergic to catgut sutures and extensive experimental and clinical research has established the fact that in most of the cases of unexplained delayed wound healing the complication can be ascribed to the patient's allergy to catgut. Henry has done much work on this phase of allergy.

**Secondary Hemorrhage**—The slipping of a ligature on a blood vessel may sometimes be followed by a hemorrhage that saturates the dressings and necessitates the opening of the wound and the ligation of the bleeding vessel. A hematoma due to oozing from veins in the cord may involve the operative wound, the scrotum and extend part way down the thigh. If not treated it may require two or three months time for it to be absorbed. The best plan is to make a small incision over the mass, evacuate the clot and apply firm pressure over the area to prevent any further bleeding. Unopened hematomas are often the cause of postoperative hydroceles.

**Traumatism of the Cord**—Traumatism or rough handling of the cord is sometimes followed by thrombosis which is the usual cause of orchitis and epididymitis when they follow hernia operations. If the veins in the cord are excised during a hernia operation postoperative hydrocele will frequently develop. The veins should be left undisturbed. Swelling of the epididymis and testis can be minimized by applying a firm muslin bandage to the scrotum immediately following operation.

**Traumatism of the Testis**—This condition is too often overlooked as a complication of hernia operations. All of us can remember the surgeon who handled the cord roughly during his operation for hernia and it was taken for granted that tumefaction of the scrotum and a swollen testis would follow. Whereas the surgeon who handled the tissues gently never had this complication. Baker and Evoy have presented an excellent study of the subject. They state that the tumefaction is due to an obstruction in the venous return circulation and to prevent atrophy of the testis its capsule should be promptly incised from pole to pole at a point opposite to the vessels and epididymis. This can be done under local anesthesia. (Fig 118)

**Embolism and Thrombosis**—Thrombosis at times develops in the veins of the cord or in the veins of the omentum, as a result of traumatism or the ligation and excision of omentum. Rarely it appears in the veins of the mesentery or in the veins of the abdominal wall. If it is localized, pain and swelling of the affected parts result. If embolism occurs, it is usually in the lungs, and an infarct of the lungs is almost always fatal. I have seen embolism appear on the sixth day after an operation for hernia in a man fifty years old. Death took place about five minutes after the first pulmonary symptoms were noticed.

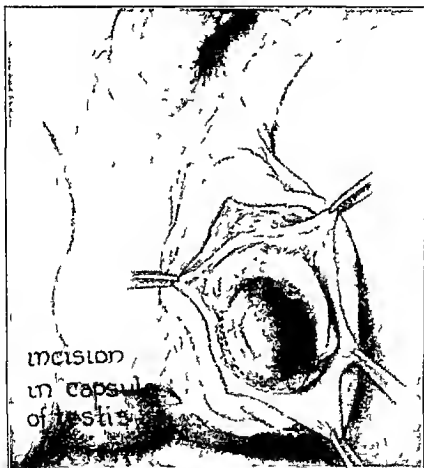


Fig 118.—Traumatism of the testis. Tumefaction of the testis due to the operation for hernia should be treated by prompt incision of the capsule of the testis.

Phlebitis of the femoral vein, with edema and swelling of the extremity of the affected side, sometimes follows an operation for inguinal hernia, with the ever present danger of pulmonary embolism. Pulmonary embolism is most frequent after operations on the upper abdomen, about 1 to 300, while hernia is only around 1 to 1,200, being somewhat higher in large umbilical hernia operations.

Thrombosis should be suspected when Homan's sign is present, namely, tenderness or pain in the calf of the leg on dorsiflexion of the foot. Often



it is accompanied by a moderate daily rise in temperature. Parsons states that in 95 per cent of the cases that terminate fatally, thromboses have their origin in the lower extremities. He advises exploration of the femoral vein without delay and administration of dicumarol as a prophylactic measure and also in the active treatment.

Oehsner considers the prognosis of thrombophlebitis good as to life, but without adequate and prompt treatment sequelae such as edema, pain, ulceration, and streptococcal infection are likely. The outlook is serious for the patient with phlebothrombosis, even though he may not appear to be gravely ill until the sudden appearance of fatal pulmonary symptoms.

**The Prevention and Treatment of Embolism and Thrombosis**—I have found that the administration of dicumarol and heparin are the best preoperative and postoperative measures to combat the danger of thrombosis and embolism. Dicumarol produces its full effect in twenty-four to forty-eight hours and does not interfere in any way with the hernia operation. It is advisable to give 300 mg. of dicumarol the first day, and 200 mg. the second day. Subsequent dosage should depend on the prothrombin time as well as the age and weight of the patient. Antidotes are fresh blood transfusion and high dosage of vitamin K. Kleinsasser, in 1946, made a complete review of the literature and reported a number of cases from an Army hospital. He points out that there are two principal types of intravenous clotting, those with a manifest inflammatory reaction, and those without. The latter are the most dangerous because of the delay in diagnosis. He states that the incidence of thrombosis and embolism following surgical procedures varies from 0.02 per cent to almost 1 per cent. When an immediate coagulant action is desired, Aggeler advises heparin along with the slower acting dicumarol. Heparin and dicumarol will prevent the formation of thrombi. They will not dissolve clots already formed but will limit their extension. The danger of hemorrhagic conditions limits the usefulness of these drugs. In an emergency, Lueka advises administering heparin for the first twenty-four hours or not more than forty-eight hours and continuing treatment with dicumarol. Heparin is expensive and is best given by continuous intravenous drip. On the other hand, dicumarol is cheap and can be administered orally, but must be controlled by complicated laboratory procedures so that blood clotting time is not dangerously prolonged. Segard and Butsch and Stewart have written interestingly on the subject.

Other important preventive measures are early rising after operation and passive exercise for the patient who is bedfast.

**Persistent Pain Following Hernia Repair**—This condition is usually due to scar, ligature or suture compression of a peripheral sensory nerve. The iliohypogastric and the ilioinguinal nerves supply the inguinal region, and pain is due to pressure on one or the other, or both. There are two methods of treatment: (1) reoperation and dissecting the nerve free of adhesions and constriction by a ligature, (2) a simpler and equally effective method is to inject 2 to 5 cc. of a 5 per cent quinin urea solution into the sensitive area at weekly intervals. Usually, three or four injections effect a permanent cure.

**Other Complications**—Complications, such as shock, fever, bronchitis, pneumonia, erysipelas, tetanus, and infection of the wound, etc., that are common to all abdominal operations will not be considered here. O'Shea stated that in 1,016 patients operated on for hernia there were deep wound infections in 3.82 per cent of the nonacute conditions and 13.58 per cent of infections in the acute or emergency operations.

## POSTOPERATIVE TREATMENT

**1 Dressings**—After operation the usual gauze dressing is applied, then a pad of sponge rubber or two or three gauze rolls, and firm pressure is made by a tight adhesive bandage. Pressure lessens the occurrence of such complications as subcutaneous collections of serum or blood clots. Sulfanilamide powder favors the formation of serum pockets and should not be used unless the wound is already infected.

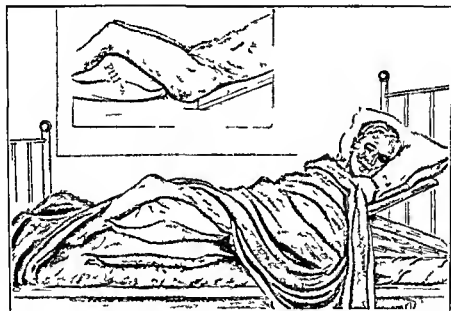


Fig. 119.—The jack knife position for hernia patients after operation. This position relaxes the muscles and takes tension off the deep sutures.

**2 Position of Patient in Bed**—The patient should be kept in a jack knife position by elevating the shoulders on two pillows and by resting the knee of the affected side on a pile of pillows. In this position the muscles and aponeurosis are relaxed, and there is less strain on the deep sutures than when the thigh is straight (Fig. 119). He should get out of bed on the first or second day after operation.

The Gatch bed is excellent for hernia patients. It permits elevating the trunk and thighs, and the patient can be made more comfortable than in the ordinary bed.

**3 Early Rising After Hernia Operations**—Rest in bed after hernia operations has been a subject of considerable controversy among surgeons. I be-

have it is best to encourage the patient on the first day to turn in bed, move his arms and legs, and sit up in bed two or three times for a few minutes at a time. Have him out on the floor for a few minutes the second day, and gradually increase the time out of bed each succeeding day. In less than a week all weakness disappears and he can get around alone.

Early rising has many advantages. It practically eliminates postoperative pulmonary complications, other complications are usually nonexistent, the patient's vital capacity is not lowered as it is when he is kept recumbent, there is less tendency to cough, there is less postoperative temperature, wound healing is improved, and there are no more recurrences than following a week or two in the recumbent posture.

Auchincloss, Bereh, Beckman, Berman, Coley (B. L.), Cutler (E. C.), Burch and Fisher, Fallis, Hanford, Lemmon, Leithausner, Martin, Powers, Schafer and Dragstedt, Sauer, and many others have long advocated early rising after hernia operations.

The only contraindication to early rising is a very large hernia or the patient's being very obese. He should be kept recumbent for five to seven days.

Burch and Fisher reported 1,919 hernia operations. All of the patients were up the first day with no ill effects. Many large clinics over a period of several years, have allowed hernia patients to get up on the first or second day, with no apparent increase in the recurrence rate.

Allen observed that early risers return to work usually within four weeks while the patient who remains in bed for twelve days seldom reports for work in less than two or three months.

Martin allows the patient to get out of bed and walk a few steps to a low armchair the first day after operation. There he can sit in greater comfort than in bed, and he can cough with less strain. He is allowed to sit up as long as he enjoys it. The next day he is up for two similar periods and he walks to the lavatory on the third day. After that, the patient remains up as long as he wishes. On the other hand, Ryan believes that recurrence is lessened if the patient is kept in bed for two weeks in a sedentary position for one month followed by two months of light work.

Hyde remarks that inguinal hernia with a distressing high percentage of recurrences is one reason for advising against the early rising after operation. Surgeon General Kirk of the Army requires not less than two weeks in bed. A majority of insurance companies still insist on seven to twelve days in bed.

**4 Postoperative Rest and Work**—All patients should be cautioned not to do any work for three months after the operation and only light work for the following six months. They should be warned against a gain in weight, which increases intraabdominal tension and puts added strain on the wound thus favoring recurrence. A change to lighter work which brings new groups of muscles into use, thus lessening the chance of recurrence should be advised.

**5 Tympanites**—Gas pains are common and are undoubtedly the most painful of all complications. They can usually be prevented by the use of the

Wangensteen continuous suction tube to prevent abdominal distention, along with a catheter or small rectal tube to carry off gases from the lower bowel. The routine use of cathartics should be avoided, because they increase meteorism and the danger of ileus.

The best preventive measures are careful preoperative treatment, a well-padded operating table, encouraging the patient to move about and turn from side to side as soon as he is returned to his bed, mild massage of the upper abdomen, and, most important of all, getting the patient out of bed on the first or second day after operation, unless there is a definite contraindication such as obesity or a very large hernia.

**6 Retention of Urine**—Measures that will help the patient to void urine voluntarily are the sound of water running, a hot water bottle over the pubis, hot or cold compresses to the perineum, a change in position, and a warm enema. Catheterization should be done only as a last resort on account of the danger of cystitis, first try letting him stand in an upright position beside his bed.

The exception to this rule is in cases of injury to the bladder when the patient should urinate or be catheterized without delay every four hours. These patients should receive argyrol instillations after each urination or catheterization to prevent cystitis and to keep them unaware of the bladder injury. Methylene blue can be administered by mouth, enough to discolor the urine, if the instillations of argyrol cannot be used.

Suppression of urine is sometimes a complication of general anesthesia. It may terminate rarely in a fatal hematuria. I was once called in consultation to see a young man, twenty-five years old, who had always had excellent health prior to an operation for simple bubonocoele. I was informed that the operation with ether anesthesia had lasted an hour. Anuria was complete for twelve hours following the operation, when a few ounces of bloody urine were obtained by catheterization. The urine gradually diminished in amount and the patient died on the third day.

**7 The Debilitated and Aged Patient**—Healing of hernia operations in the enfeebled or aged patient is hastened by the liberal administration of the vitamins, especially vitamin C, and proteins to promote increased fibroblastic activity of the tissues. In cold climates some surgeons hesitate to perform nonurgent hernia operations on the elderly patient during the winter months, but wait for warm days as the patient's resistance is higher in summer.

Zollinger advised a thorough examination of middle-aged and old men before undertaking operation. Too frequently, the urinary tract, or even gastrointestinal carcinoma, is responsible for the patient's symptoms. I recall 3 cases of the latter group in my work.

Dulin reported 301 cases of hernia operations on patients over sixty years of age, 38 were strangulated, and of these 6 died, in 263 elective operations there was a mortality of 3.8 per cent, 8 patients developed pneumonia, and the hernias that recurred totaled 20.5 per cent. In conclusion, Dulin states that the repair of inguinal hernia in the aged is not only relatively dangerous but

unsatisfactory. Personally, I believe the injection treatment is much safer for the elderly patient, provided the hernia is suited to this method. This is based on fifteen years' experience with the injection treatment.

**Penicillin**—Penicillin should be administered when infection is anticipated or in case delayed wound healing is a possibility. The usual dosage is 20,000 units every three hours for a period of twelve to twenty-four hours before operation and a day or two postoperatively. Sometimes it is more practical to give daily doses of penicillin in oil or wax. Cohen reported prompt healing of infected wounds following the injection of penicillin in 100,000 units, repeating the dosage as needed.

**Postoperative Pain**—As a rule the patient should be kept comfortable after an operation for nonstrangulated hernia by small doses of sedatives for the first twenty-four hours. Opiates are contraindicated in children, in the aged, and after operations for strangulated hernia.

**Diet**—After operations for simple reducible hernia, liquid diet is best for twenty-four hours to forty-eight hours, then soft diet.

**Support of the Scrotum**—The dressings are held in place by adhesive straps, and a wide piece of gauze is placed under the scrotum. A snugly fitting spica bandage of unbleached muslin or cotton flannel is applied so as to hold the gauze supporting the scrotum and is fastened by safety pins. This bandage should be put on so that it holds the scrotum snugly up against the pubes. It not only gives the patient support permitting him to turn about in bed, but also reduces the danger of secondary hemorrhage, orchitis and epididymitis.

In adults an elastic bandage applied in St. Andrews' cross fashion will help to hold the dressings securely, and to keep the thigh from being moved too freely. Some patients are more comfortable if a suspensory is worn while in bed to support the testes.

#### INSTRUCTIONS FOR INGUINAL HERNIA PATIENTS AFTER OPERATION

The site of your hernia operation will be weak for a few months. Your improvement should be progressive, and you can do much to get well and stay well by observing the following instructions:

The hernia wound will be sensitive for several months. You should not let anything rough or irritating press on it. You should wear a truss or corset, or an elastic abdominal support for a few months, especially if you are overweight or have a pendulous abdomen. Be careful that it is loose above and fits snugly only over the wound. You must not gain in weight for at least a year, as that increases the danger of the hernia recurring.

You can take light exercise such as short walks and riding on smooth roads. Jolting strains, lifting, swimming, horseback riding and sports or work that requires strenuous exertion must be avoided for at least three months. After that time you can do light work, heavy manual labor should be avoided for at least six months. It may be advisable to change your occupation so that new groups of muscles will be brought into use.

You will gain strength most rapidly if you get plenty of sleep, avoid all kinds of mental excitement, and get an abundance of fresh air and eat simple wholesome food. Live principally on milk, buttermilk, butter, cereals, fresh vegetables and fruits.

Avoid constipation by natural means, as far as possible. Drink plenty of water, eat coarse vegetables and fruits, and whole wheat or bran bread. Establish a regular hour for going to stool. Sometimes a mild laxative is necessary—salts and strong cathartics should be avoided.

If in doubt about anything, consult your physician, who has been informed fully regarding your operation, and knows the treatment you should follow. Please report your condition by mail every three months for the next two years.

(These printed instructions are given to patients when they go home.)

### PROGNOSIS IN NONSTRANGULATED HERNIA

**Mortality Rate Following Operation for Nonstrangulated Hernia**—In 8,000 operations for nonstrangulated inguinal hernia in adults which I collected from the literature, there were 30 deaths (0.38 per cent). O'Shea reported 710 operations for nonacute hernia with 5 deaths (0.7 per cent). Von Novak and Rigler reported a series of 3,604 hernia operations. The mortality rate in simple hernia was 1 per cent, and for incarcerated and strangulated hernia, 15.2 per cent.

**Contraindications to Operation**—The following conditions usually contraindicate operation on reducible and nonstrangulated hernia: the acute infectious diseases erysipelas, syphilis, pulmonary tuberculosis, emphysema, bronchitis, diabetes, advanced cardiovascular and renal disease, and acute urethritis. It is generally agreed by those who have had the most experience in pediatric surgery, that the operation for reducible hernia is advisable in infants over two months of age.

Temporary contraindications to operation are infections, abrasions, and diseases of the skin in the inguinal region.

### TREATMENT OF STRANGULATED INGUINAL HERNIA

**Early Diagnosis**—Evans and Biggers have emphasized the importance of early diagnosis of intestinal strangulation if the mortality rate is to be kept low. They describe a new sign, the *position of relief*, that is helpful in making a prompt diagnosis. The posture assumed by the patient in bed tends to relieve the pain by lessening the traction on the mesentery.

The treatment of strangulated inguinal hernia is similar to the treatment of strangulated hernia elsewhere, and the same general principles apply to both children and adults. If the strangulation is recent, it is usually justifiable to try gentle taxis, if it has lasted from twelve to twenty-four hours, taxis is too dangerous, and only operative treatment should be considered.

**Taxis**—Taxis is little used at the present time on account of the danger of returning gangrenous intestine to the abdominal cavity, and the chance of reducing the strangulation *en masse*. The directions for taxis are given because the patient may refuse operation, his condition may not warrant it, and circumstances may be such that immediate operation is impossible. The method of taxis described by Cooper has never been improved, he directed that the bladder be emptied and the patient placed in the recumbent position with a pillow under his shoulders and another one under his hips, the thighs are elevated to a right angle with the body and the knees brought close together to relax the internal ring. The surgeon stands at the right side of the patient. With his right hand, he presses on the fundus of the hernia, and at the same

time, with the index finger and thumb of the left hand, he gently moves the neck of the sac from side to side to aid reduction. If a part of the tumor can be reduced the rest generally follows without difficulty.

The hernial contents that come down first lie in the front part of the sac while those that come down last lie behind. For this reason the viscera in the posterior part of the sac should be reduced first.

The degree of force must be moderate, but continuous. Violent manipulations frequently rupture the intestine. The direction of pressure should be toward the anterior superior spine. Richter advises drawing down the sac to straighten out its neck while making pressure. If the hernia cannot be reduced in five minutes it is useless to continue taxis longer. Taxis is aided in infants and children by holding them by their feet head downward. In version of the patient, as a means of reducing hernia was practiced by the ancients and was revived after the Dark Ages by Guy de Chauliac.

Other measures that often aid taxis are hot baths, local applications of cold compresses, ice ether or ethyl chlorid spray, in isolated cases hot applications. Chiropractors strike a sharp blow with the fist a dangerous procedure.

**Accidents of Taxis**—In case taxis fails operation should be resorted to immediately as there is always grave danger that the efforts of taxis may have ruptured the intestine. If taxis is apparently successful the patient should be carefully watched for several hours for symptoms of laceration of the intestine, hemorrhage from the blood vessels of the omentum or mesentery or reduction of the hernia *en masse*.

**Signs of Reduction**—In reducing intestine and omentum the intestine reduces first with a gurgling sound. The patient often complains of pain and children cry from it especially when the hernia has been down for some time, and it is probably due to peristaltic contractions of the intestine set up by the manipulation of taxis. The omentum and mesentery are ordinarily difficult to reduce and sometimes they are adherent to the sac so that complete reduction is impossible. Cases of this type nearly always have a history of an old incompletely reducible hernia.

**Strangulated Interstitial Hernia**—On account of the shortness of the sac and the comparatively large hernial opening strangulation in interstitial hernia is infrequent. When it does occur it is often incomplete and the symptoms are indefinite. When there is no tumor in the scrotum or labium majus diagnosis may not be made until operation. Properitoneal hernias are commonly misdiagnosed as inguinal hernias strangulated *en masse*.

**Complications of Strangulated Hernia**—In addition to the changes that take place within the sac contents strangulated hernia may be complicated by the following conditions: ulceration of the skin over the sac which may be followed by spontaneous rupture; laceration of the mesentery outside of the sac; rupture of intestine from external blows; lesions of viscera in the abdominal cavity; gangrene of the cord and testis due to pressure of the hernia on the cord in neglected cases; and proximal ulceration of the intestine—a condition of more importance than is generally supposed.

I observed a case in which the strangulation had lasted for three days Taxis had been attempted, and the skin was lacerated and was so edematous and ecchymosed that it resembled a large superficial abscess. On opening the mass under local anesthesia, I found that the tranma of taxis had ruptured the aponeurosis of the external oblique. The contents of the sac, which consisted of most of the small intestine and part of the ascending colon were gangrenous.

**Multiple Strangulation**—Two or more hernias may be strangulated in the same patient at the same time. Seigliano observed the case of a man, aged fifty years, with simultaneous strangulation of an indirect and direct hernia on the same side. Other cases of multiple strangulation are reported in the literature, but the condition is very rare.

**Proximal Ulceration of Intestinal Obstruction**—The importance of inspecting the intestine above the point of constriction for solitary perforation or ulceration must be borne in mind in every case of strangulated hernia, even though the intestine is apparently viable. If the ulceration is overlooked at operation, perforation may occur hours afterward, resulting in peritonitis and death.

**Division of the Constriction**—The old method of blindly dividing the constriction after pushing a grooved director through the internal ring along side the neck of the sac should never be used on account of the danger of hemorrhage, and the possibility of the strangulation being in the sac itself, and besides, it is of the utmost importance to open the sac so that the contents can be dealt with.

The correct method is to open the sac, as described for the regular operation for inguinal hernia, follow it upward to the internal ring, locate the constriction, and cautiously divide it as it is pulled down into plain view by forceps applied to each edge of the cut sac. In this way there is little danger of dividing the deep epigastric artery, but if it is accidentally cut, it is easy to pick up the bleeding ends and ligate them. In indirect hernia the constriction should be divided upward and outward, in the direct variety it should be divided upward and inward.

When it is impossible to determine the position of the deep epigastric artery, the safest plan is to open the peritoneum above the constriction—a procedure that should also be resorted to when the swelling is so tense that it is impossible to introduce a director between the constricting ring and the sac. The danger of wounding the bladder must always be thought of, especially in direct hernias.

**Treatment of Strangulated Intestine**—After all constricting bands are freed the intestine should be wrapped in hot compresses, tested for viability, and carefully examined for gangrenous or necrotic spots. If gangrene is extensive, intestinal resection is indicated, if it is limited to a narrow band around the caliber of the intestine it can often be invaginated into the healthy portion of the loop and the healthy edges closed over the gangrenous intestine.

If the necrotic spots are small, not over  $\frac{1}{2}$  inch (1.25 cm.) in diameter, the gangrenous area can be inverted and healthy serosa sewed over it, care



being taken not to produce too much narrowing of the lumen of the intestine. Whatever method is used a piece of omentum should be tacked over the line of suture to prevent leakage and the formation of adhesions.

The radical operation for the repair of the hernia should follow the treatment of the strangulated sac contents if the patient's condition permits. When the wound has been contaminated by septic sac contents it is sometimes possible to limit the infection to a small area if three or four sutures are passed through the subcutaneous tissues including a deep bite in the aponeurosis so as to close all dead spaces. These sutures can be placed about an inch (2.5 cm) apart from above downward.

**Strangulation Following Operation for Hernia**—In very rare instances when the internal ring has not been sufficiently narrowed intestine may pass through the opening and become strangulated when the patient gets up and walks.

**Intrasaccular Strangulation**—Constricting bands inside of the hernial sac sometimes cause strangulation. They may be due to inflammation or to narrow points in the unobliterated processus vaginalis. A number of cases have been reported in the literature. The condition is common in umbilical hernia.

**Mortality in Strangulated Hernia**—The mortality in strangulated hernia varies from 15 to 50 per cent depending on the promptness with which operation is resorted to, the age and general condition of the patient, the method of operation and the choice of anesthetic.

Simple reduction of the intestine before gangrene develops has the most favorable prognosis. When there is gangrene the mortality is lowest when only omentum is involved, is higher when resection of small intestine is required and highest when partial excision of the colon is necessary.

The greatest factor in reducing the mortality in strangulated hernia is the use of local anesthesia and the employment of the two stage operation in borderline cases.

**Test for Viability of Strangulated Intestine**—The viability of the intestine can be established immediately by the fluorescein test advocated by Herrlin, Glasser and Lange. Another method is to inject procaine hydrochloride along the vessels leading to a strangulated loop of intestine. Vascular and muscular contractions follow if the intestine is viable and a restoration of circulation is hastened.

Deep inhalations by the patient of 100 per cent oxygen is a simple method for determining the condition of strangulated intestine as the color changes quickly if the gut is viable.

**Preoperative and Postoperative Treatment of Strangulated Hernia**—Before and after operation fluids should be administered intravenously to restore the body level that has been lowered by nausea and vomiting. One should remember that too much fluid is dangerous as it may cause pulmonary edema. Blood transfusion is usually advisable to replace blood cells and minerals. Distention of the abdomen should be reduced by the use of the Wangenstein suction tube in addition to the usual low rectal tube. The bladder should be emptied by a catheter just before operation.

Spinal anesthesia is suitable for the good risk patient. It is contraindicated when the systolic blood pressure is below 120 mm, with very high systolic pressure, in cerebrospinal disease or paralysis, when the patient is gravely ill, in infants and children, in advanced age or when the patient is otherwise a poor risk, in such cases local anesthesia should be used.

The postoperative treatment of strangulated hernia should include the breathing of 95 per cent oxygen to help displace by diffusion the nitrogen contained in the distended or strangulated bowel. Blood transfusion and physiological salt solution are used to replace loss of blood cells and minerals by vomiting or otherwise.

An impaired circulation or damaged myocardium is benefited from a 50 per cent dextrose or glucose solution, giving 100 to 200 cc by venoclysis twice daily, before and after operation. The addition of some form of chloride is also helpful. Penicillin, 20,000 units hypodermically every three hours, one day before operation and two days postoperatively, is advisable to combat infection. If administered orally the dose units should be tripled.

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## CHAPTER XVIII

### INGUINAL HERNIA IN INFANTS AND CHILDREN

Inguinal hernia in infants and children differs from the adolescent and adult types in several ways. At the age of two years the infant becomes a child, and at twelve the child becomes an adolescent.

**Inguinal Canal**—The inguinal canal is comparatively much shorter in children than in adults, in infants it is nearly straight, and the internal and external rings are almost on the same plane. Maerckady states that the canal at birth is no longer than the thickness of the abdominal wall. Jason has discussed the pathology at length. (For details on the descent of the testis and patency of the processus vaginalis and the anatomy of inguinal hernia in infants and children, see Chapter XII.)

**Frequency of Indirect and Direct Hernia**—Practically all hernias in infants and children are indirect. Direct hernias are very rare. In 4,114 operations on patients under fourteen years of age, Coley (W. B.) and Hogue found 21 direct hernias.

In a series of 150 inguinal hernia operations in infants and young children Hogg observed only one direct hernia.

**Bladder**—In the newly born and in infants, the bladder lies high, and Camper believed that this affords a certain amount of protection to the internal rings. In operating on young children, the proximity of the bladder should be considered.

**Predisposing Causes in Infants**—Inguinal hernias are most common in premature infants or in those who are underweight, and whose muscles are poorly developed or weakened from disease and unable to withstand the increased intraabdominal pressure of crying, colic, flatulence, bronchitis, whooping cough, etc.

**Contents of the Sac**—Small intestine is the sole content of the sac in 90 per cent of the hernias in infants and children, omentum is next in frequency. Other viscera that are sometimes found in the sac are cecum, appendix, sigmoid, colon, bladder, ovary, tubes, uterus, and in rare instances, the stomach, liver, kidney, pancreas and ureter may be found. Intrascacular adhesions are rare in children. If any of these organs are in the sac, there may be unusual symptoms referred to the viscera involved.

#### Symptoms and Diagnosis

The symptoms of reducible inguinal hernia in infants are usually confined to irritability, constipation, and colic. The infant cries more than usual, and is underweight and takes its food badly.

In male infants, palpation of both spermatic cords often shows one to be the larger. In fat babies under one year, the cord is short, the testicles are drawn up, and diagnosis is frequently difficult. After one year, the scrotum is more pendulous, and the cord is longer.

Many of the symptoms in children are similar to those in adults. The child is backward in his studies and cannot participate in active games with other children. I recently saw a boy, three years old, who for two weeks previous to the appearance of a small hernia, had had a decided limp with some pain in the affected side.

The hernia is usually small and confined to the inguinal canal or to the upper part of the scrotum. (Fig 120.) The pillars of the external ring are often poorly developed and relaxed. For this reason, when the hernia is large and of the serotal variety, it frequently strangulates.

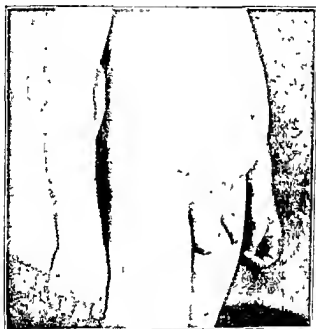


Fig 120.—Right indirect inguinal hernia in a boy aged five years. The sac has passed the external ring and is in the upper part of the scrotum.

If the child does not cough, and cannot be induced to cry, if pressure is made over his abdomen with the palm of the examiner's open hand, the hernia will usually descend. If the external ring is dilated and relaxed, the index finger can sometimes be introduced into the inguinal canal and can follow the cord up to the internal ring. Because the inguinal canal passes directly backward, it is often impossible to differentiate an oblique hernia from a direct hernia.

In female children it is sometimes difficult to locate the external ring, and the hernia does not descend as readily or as far as in male children. If it is irreducible, it almost always contains the ovary and tube, and in rare instances,

the uterus. As a rule the diagnosis in both infants and children is simple. Hydrocele of the cord or of the canal of Nuck occurs frequently and is to be differentiated from hernia. (See differential diagnosis under inguinal hernias Chapter XIV.)

In infants and children a hernia is sometimes translucent on account of the thinness of the intestinal walls; this fact should be remembered in differentiating hydrocele and hernia. It is suggested a rectal examination to aid in differentiating strangulated hernia from hydrocele. This method is applicable only to infants and young children in whom the examining finger can reach the os pubis.

**Appendicitis and Hernia**—When an infant or child complains of pain in a hernia or undescended testicle appendicitis should always be suspected. Venn reported 53 cases of appendicitis and hernia operated on in infants and children. He found it very difficult as a rule to remove the appendix through the hernial incision in those under four years of age. The double operation is ordinarily to be preferred.

**Cause of Strangulation**—The cause of strangulation is the same as in young adolescents and adults: a constriction of circulation due to a narrowing and too much contents. Goldberg and Rambai noted 6 cases of strangulated hernia in 44 hernias in premature infants. They believe that crying and increased intraabdominal pressure is an important factor in producing strangulation.

**Symptoms of Strangulation**—Strangulation may occur any time after birth. In infants the most striking symptoms of strangulation are profound collapse with rapid thready pulse and cold damp extremities vomiting first of stomach contents, followed by intestinal contents and violent continuous and uncontrollable screaming. Inglum reported a child who screamed continuously for thirty six hours until relieved by operation. There is always constipation and scanty urination sometimes retention of urine. The symptoms in children especially the older ones are similar to those found in adults. Johansson reported the case of an infant three weeks old in whom strangulation of an inguinal hernia took place during a tetanic convulsion.

**Mortality of Untreated Strangulation in Infants**—According to Clément the mortality of untreated strangulation in infants is 37 per cent after the first twenty four hours 54 per cent after forty eight hours and 78 per cent after seventy two hours.

**Spontaneous Cure of Hernia in Infants and Children**—Owing to the fact that patency of the processus vaginalis exists at birth in 50 per cent of infants hernia is most frequent during the first few months of life. By the end of the first year spontaneous obliteration of the processus vaginalis has taken place in a majority of infants when hernia rapidly decreases in frequency. This is one of the strongest arguments in favor of the conservative treatment.

Macready reported 17 538 inguinal hernias occurring in males. Of these 3 158 first appeared during the first year of life 670 between the first and fifth years and 390 between the sixth and tenth years. Inguinal hernia is four times more frequent during the first year than in adult life.



Ochsner (A J) stated that 95 per cent of all hernias in infants and young children will close spontaneously if the intraabdominal pressure is lessened sufficiently to keep the sac empty. This is accomplished by a restricted diet, the prevention of coughing and by keeping the little patient in bed with the foot of the bed elevated. Sometimes fourteen hours' sleep each night with the foot of the bed elevated, will keep the sac empty.

### Treatment of Inguinal Hernia in Infants and Children

There is much diversity of opinion as to when operation should be undertaken on infants and children. I believe that small indirect inguinal hernias can best be operated on when the infants are two to four months old by a simple removal of the sac.

The truss treatment for infants has its advocates but it seems a waste of time to me. Knox urges operation while the infant is only a few weeks old. The results following truss treatment in young children are sometimes favorable. Coley (W B) estimated the number of cures at over 50 per cent. De Garmo placed it at 75 per cent and Ochsner believed it is as high as 95 per cent.

**Dangers of Operation in Infants and Young Children**—There is a definite mortality following the radical operation in infants and young children which while lower than in adults is still higher than in children between four and twelve years of age. Otti stated that the mortality rate was 1.45 per cent under six years of age and 0.71 per cent from six to twelve years of age.

The infant is liable to develop pneumonia following the anesthetic and is very susceptible to gastrointestinal disorders when confined in bed. There is increased danger of wound infection from urine and feces and when the baby is confined with other sick children there is considerable danger of such infectious diseases as diphtheria, scarlet fever, measles, erysipelas and whooping cough.

**Mechanical Treatment**—A bandage or worsted truss can be applied to an infant under a month old. After this age it can wear a light frame truss covered with muslin or flannel with a soft cloth placed between the pad and the skin to prevent chafing. The skin must be kept clean, dry and well powdered at all times. If the little patient does not cry at night the truss may be left off or replaced by a light bandage.

**The Truss**—The best truss for infants and children is of the frame or elastic type and should hold the hernia by resistance and not by pressure on the hernial ring as with the spring truss.

A truss can be applied to an infant one day old if necessary. Just as much care should be exercised in fitting a truss to an infant or child as is given to an adult. The truss should be changed frequently as the child grows. The rules for fitting of trusses to adults apply also to infants and children.

**Indications for Operations in Infants and Young Children**—Operative treatment is indicated in young infants as soon as a diagnosis is made and immediately regardless of the age of the patient under any one of the following conditions: when the hernia is strangulated or irreducible, when the hernia

cannot be retained by a properly fitted truss when the patient cannot wear a truss owing to deformity or disease when the hernia is complicated by a hydrocele in the inguinal canal when there is adherent omentum or intestine in the sac when there are recurrent attacks of strangulation, when the parents refuse the truss and insist on operation and when the testicle is in the inguinal canal and only partially descended

Delayed descent of the testicle may make the fitting of a truss impossible or the pressure of the pad on the testicle may cause pain and discomfort, as well as atrophy of it and possibly malignant degeneration

### Operation

The operation preferred is simple ligation and excision of the sac. The incision is short not over 1 inch (2.5 cm.) and is made over the internal inguinal ring and through the aponeurosis of the external oblique muscle and the cremaster. The sac is separated from the cord structures and ligated as high as possible, using moderate tension on the sac to bring it down while the ligature is being applied.

Beckman has pointed out the importance of leaving a substantial stump when the sac is cut away. It is his opinion that many recurrences in indirect hernia operations in children are due to a slipping of the ligature at the primary operation.

The wound is closed with one or two deep sutures in the cremaster fascia and one or two stitches to bring together the edges of the external oblique aponeurosis. Three or four sutures are then placed to bring together the subcutaneous tissues and skin incision.

In Great Britain the simple ligation of the sac operation on young infants is usually performed in the outpatient department. Herzfeld says hospitalization is unnecessary. Coley (W. B.), Buford Horsley, and Thorndike and Ferguson have contributed to the literature on the operative treatment of hernia in infants and children.

**Complications**—Sudden pallor and hyperthermia known as Ombredanne's syndrome is a serious complication that sometimes develops after a prolonged or grave operation on infants. It has been discussed in detail by Corda and by Dana and Ghoulia Honra.

**Injection Treatment**—I have cured many little patients as young as two months old by simply injecting 1 c.c. of mild sclerosing solution such as procaine quinae phenol one half strength. Four to eight injections are usually sufficient and it is easier and safer for small inguinal and umbilical hernias than an operation that ligates the sac.

**Mortality and Recurrence in Infants and Children**—Stiles reported 360 infants and children operated on for inguinal hernia with 5 deaths due to the operation and 4 recurrences. Sulzer reported 352 infants and children operated on for inguinal hernia with 3 deaths. Kovacs reported 232 patients operated on for inguinal hernia with one death due to the operation of 144 patients treated there was one recurrence. Pfäehler reported 46 patients operated on for inguinal hernia with no deaths and one recurrence.

**Postoperative Treatment**—Infants are only slightly inconvenienced by operation. They are able to nurse soon afterward and can be given to the care of their mothers almost immediately. Older children sometimes require a dose or two of paregoric for the pain and restlessness.

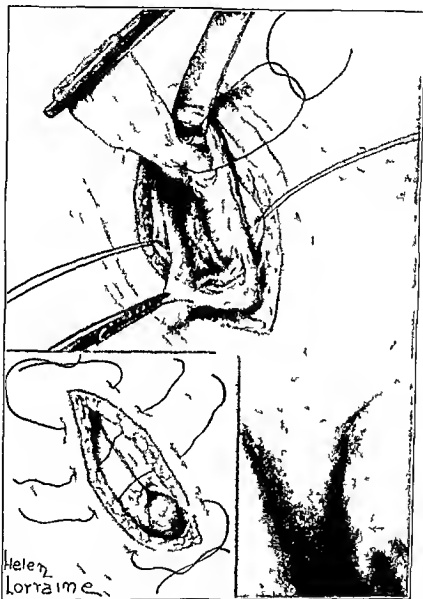


Fig. 101.—Operation for inguinal hernia in infants and children. The sac is exposed, ligated and excised, and the wound is closed with one or two deep sutures and three or four interrupted sutures for the subcutaneous tissues and skin.

The head of the bed is kept elevated so that when the child urinates there is less danger of contaminating the wound. In male children I stretch a piece of gutta serena or rubber sheeting or adhesive plaster over the penis.

and fasten it on either side to the thighs. A bed arranged so that the covers are held up by a frame and do not touch the child, will prevent the danger of wet covers coming in contact with the wound dressing, soiling and loosening it. Children who can walk alone should be kept in bed one to two days.

Reed states that postoperative increased intraabdominal tension, when due to constipation and flatulence, can often be relieved in infants by reducing the amount of protein in the diet and giving more cream.

### Treatment of Strangulated Hernia in Infants and Children

**1 Taxis**—If the strangulated hernia is of only a few hours' duration, an attempt to reduce it by cautious taxis is sometimes justifiable. The child can be placed in a warm mustard bath or hot compresses may be applied to the tumor which is gently kneaded. If this is unsuccessful sometimes reduction can be effected by slinging the child up by its feet, with its head downward, and while in this position making taxis on the strangulated mass. Often it is helpful to have the foot of the bed elevated while applying gentle pressure on the tumor, and sometimes flexing the thigh and rotating it outward will aid taxis.

**2 Radical Operation**—In strangulation of more than a few hours' duration, immediate operation is imperative without preliminary attempts at taxis, in strangulation of very short duration, if taxis is unsuccessful after a few minutes' trial, operation must be done at once without further attempt at taxis.

Shock and chilling of the body must be guarded against by placing an electric pad under the little patient on the operating table, or by surrounding him with hot water bottles. The quickest and simplest operation must be done.

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## CHAPTER XIX

### THE PROBLEM OF RECURRENT HERNIA

Recurrent inguinal hernia is a subject that most surgeons do not like to discuss and it is accorded only brief mention in most textbooks on general surgery. This group represents 15 per cent of all hernia patients who consult me. The articles on the subject in the current surgical literature are few and far between, but surgeons do not hesitate to bring forth new operations for hernia.

The treatment of hernia is a subject of marked divergence of opinion among surgeons and is likely to remain unsettled as long as recurrence statistics reports vary from zero to 30 per cent. Dissatisfaction will remain until the perfect operation is devised and universally adopted. Unfortunately we will still have with us the patient with deficient muscles and fascia and other handicaps to tax the skill and try the patience of the surgeon. Bull in 1889 stated that recurrent hernias were unmanageable and the despair of the surgeon. Hutchins in 1947 remarked that we still have with us the patients with recurrent hernias who go from one clinic to another for three or four operations until whatever tissue tone there was originally is dissipated. This is the reason for devoting a separate chapter to recurrent hernia.

A casual survey of the literature quickly discloses good, fair and poor results of the same operation by different surgeons. Those who secure excellent results with silk and cotton sutures are unfortunate with fascia. On the other hand those experienced and skillful with fascia have a higher recurrence rate when they venture into the realm of silk or cotton. Fine steel wire is gaining in popularity but requires special skill and a meticulous technique.

Minty and Minty have aptly summed up the situation. Skillful surgeons often have success with poor methods while amateur and careless operators have a large number of failures by any method.

Experienced surgeons have very few recurrences but this favorable percentage does not hold good with physicians not specially trained in hernia surgery. As Dr. Costa remarked, "Most surgeons belittle recurrences. However, the longer one observes hernia patients after difficult operations the lower the percentage of cures. One by one with the passing years they slip from the cured group. Most of those who come to me with recurrence state that their surgeon does not know of their relapse therefore that surgeon has these patients on his record as cured of their hernia."

E. M. Stanton stated that patients who are operated on by experienced surgeons will show indirect recurrent hernias 5 per cent the first year and 1 per cent additional recurrence each year thereafter. Direct hernias traced over a five year period showed 25 per cent recurrences.

I believe that any hernia developing at the site of a previous operation should be classified as a recurrent inguinal hernia, regardless of the practice of some clinics of hairsplitting and making an evasive diagnosis of muscle hernia, muscle weakness or bulging.

Gallie and LeMesurier remarked that recurrences following operation during World War I were so common that the Canadian military authorities ruled that hernia disqualified a man for service whether or not he had had a hernia operation.

Patients who have immediate or early recurrences usually return to the surgeon who performed the original operation, while those who have late recurrences five to fifteen years after the first operation seldom return to the first operator. This accounts in part for the low recurrence rate from some clinics. Few checkups are carried out by longer than two to five years after operation. Mail checkups are unsatisfactory because few patients are able to recognize a small recurrent hernia especially if the patient is obese.

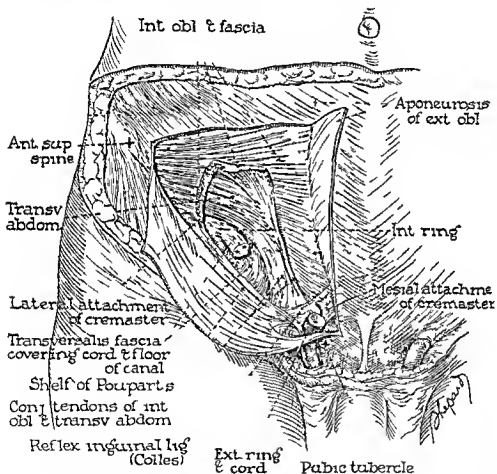


Fig 122—The muscles and fascia of the inguinal canal and rings

Mair remarks that some surgeons maintain that the migrant recurrent operation patients cancel each other out all of which may be a beautiful thought but is not a sound or logical surgical deduction.

My observation is that the patient only too often seeks another method of treatment, reasoning that if the operation did not hold once it will fail again. This is borne out by my statistics as 15 per cent of the private hernia patients

who consult me have had one or more unsuccessful operations elsewhere. Industrial patients migrate less, as the insurance company often insists that they return to the surgeon who performed the original operation.

**Recurrent Hernias That Are Indirect**—While most recurrent hernias are direct, there are many of the indirect variety, especially if the first operation failed to remove all of the sac and the closure of the wound was faulty. Brigadier Edwards, in 1943, published an excellent monograph on recurrent hernia. He reported the findings in 131 recurrent inguinal hernias in men of military age (twenty to forty five years) and found that 98 cases, or 75 per cent, were indirect, with a new sac along the cord, thus, the original hernia was reproduced. Of the direct type, 13, or 10 per cent, had a funicular sac that came through a well-defined opening in the transversalis fascia just lateral to the outer border of the insertion of the conjoint tendon. Twenty cases, or 15 per cent, simply showed a diffuse saucer shaped sac (Fig 122).

**Time of Recurrence in Inguinal Hernia**—Most surgeons state that when recurrence takes place it usually occurs in the first few weeks with about 65 per cent showing up within the period of six months and 95 per cent within two years after operation. While this may hold true over short periods for clinics and surgical specialists who do not follow up their patients for a long period only two to five years I do not believe it applies to the average surgeon.

I believe the figures I have collected are more accurate in many particulars. In a series of 2,250 inguinal hernia patients that came to me over the last five years I found that there were 286 with recurrences following operations elsewhere. A study of the 286 patients' case records shows that approximately 25 per cent developed hernia immediately after operation, 28 per cent in the first six months, another 15 per cent in one to six months, 30 per cent from six months to five years after operation, 15 per cent in five to ten years, 10 per cent in ten to twenty years, and 5 per cent in twenty to thirty years after operation. Falls in a study of a large series of recurrent hernias, found recurrence was very common five to fifteen years after operation. He stated that few clinics follow their patients more than five years after operation. Because of the uncertainty of late recurrence, Cohen aptly remarked that the hernia operation is the only major operative procedure in which we do not know what the end result will be.

**AGE OF RECURRENT HERNIA PATIENTS**—In 332 recurrent hernias in 286 patients the age was given

AGE (YEARS)	19	10-19	20-29	30-39	40-49	50-59	60-69	70-79	TOTAL
NO OF CASES	3	5	27	49	57	81	53	11	286

**TIME OF RECURRENCE FOLLOWING SINGLE OPERATION**—In 236 cases the time of recurrence was as follows

IMMEDIATELY	MONTHS		1-5	6-10	YEARS		20-29	30-39
	1-6	7-11			11-19	20-29		
64	23	22	56	23	30	12		1

**BILATERAL OPERATION**—Seventy five patients had bilateral operations. There was bilateral recurrence in 33, right side recurrence in 26, and left side recurrence in 25.



*Time of Unilateral Recurrence and Side*

IMMEDIATELY		YEARS							
		1 5		5 9		10 19		20 29	
R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
8	6	9	13	5	2	3	3	2	1

*Time of Recurrence on Both Sides*

IMMEDIATELY		MONTHS		YEARS					
		1 4		1 5		5 9		10 19	
NO. OF CASES		13		7		4		1	

**Operation as a Cause of Hernia on Opposite Side**—In 74 out of 2 234 patients there was a history of a single hernia operation followed by the appearance of a hernia on the opposite side

Time of appearance of hernia on *sound* side after operation on opposite side was as follows

IMMEDIATELY		MONTHS		YEARS							
				1 5		6 9		10 19		20 29	
R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
1	11	1	1	3	13	7	5	11	8	6	4

**Statistics on Recurrent Inguinal Hernia—**

AUTHOR	YEAR	NO OPERATIONS	SUTURE MATERIAL	RECURRENT (PER CENT)
Burton and Ramos	1940	711	Not stated	9.4
Andrews and B. Swell	1934	1 545	Not stated	20.0
Martin	1944	Not stated	Not stated	12.0
Glenn and McBride	1936	26 recurrent (20 followed up)	Not stated	30.0
Von Novak and Rigler	1929	3 604	Not stated	7.9
Shelley	1940	1 668	Not stated	7.2
Stein and Casten	1943	8 099 (various operations)	Not stated	10 to 33
Mair G. B.	1945	Not stated (Bassini operation)	Not stated	11.8 indirect 17.6 direct
Tanner	1942	Not stated	Not stated	20 to 25 indirect higher for direct
Fite	1938	1 514	Not stated	9.1
Schroeder	1944	1 078	Not stated	9.5
Anderson	1943	Not stated	Not stated	16.0
Lich and Samson	1943	17 Cooper lig operation	Not stated	3.1
Lich and Samson	1943	22 Cooper lig operation	Recurrent	0.0
Stein and Brown	1940	2 000	(Silk or catgut)	3.0
Joyce	1940	760	(Fascia)	2.04
Martin	1946	623	Plastigut	1.17
McArthur (S. W.)	1946	Not stated	Catgut	9.0
McArthur (S. W.)	1946	Not stated	Autoplastic (fascia)	1.4
Christopher and Penna	1947	6 379	Nonfascial	7.1
Christopher and Penna	1947	130	Fascia	3.1

McCLOSKEY AND LEHMAN	DIRECT	PER CENT	INDIRECT	PER CENT
8,133 operations (collected in literature) (nonfascia sutures)	1,007		5,889	
Recurrent		21		10
Recurrence variations from different clinics	68 to 42		16 to 18	
480 operations with fascia suture	177		273	
Recurrent		3		2
Recurrence variations from different clinics	0 to 9		0 to 46	
82 operations with fascia suture (personal cases) direct and indirect		36		

Burdick, Gillespie, and Higinbotham in 1937 reported the results following fascial suture operations at the Hospital for Special Surgery, New York. Fascial sutures were used for direct inguinal hernias, combined direct and indirect inguinal hernias, large scrotal hernias, all recurrent hernias, and all ventral hernias including the umbilical and the epigastric types. In 1,485 operations on 1,092 patients, there were 25 operative deaths. The percentage of recurrence following the use of autogenous fascial sutures was 27.7 per cent, it was 28.3 per cent after homologous fascia, and 35.5 per cent recurrence followed the use of ox fascia sutures. Davis (L.) reported 1,500 hernia operations at the Massachusetts General Hospital. Of these he traced 754, and found 8 per cent of recurrences, of the 75 operations done under local anesthesia, there were only 2 per cent of recurrences. In 88 direct hernias, 15 per cent recurred. He believed that the most important causes of recurrence were cough, hematoma, and sepsis.

Sir Max Page, consulting surgeon to the London Metropolitan Police force, in 1943, stated that in 295 operations for hernia, 206 were reexamined in a period of five to nine years, and 20.2 per cent of the patients had recurrences of hernia. Edwards, in 1943, estimated the recurrence rate for operations in the British Army at 12 per cent. Based on a series of 142 cases the operations and results were as follows:

TYPE OF OPERATION	NO	PERCENTAGES	PER CENT
Excision of sac only	86	8	9.3
Fascia lata repair	39	6	15.4
Bassini, McArthur			
Fowler, Bloodgood etc	17	3	17.6
Totals	142	17	12.0

McLaughlin and Brown, in 1946, studied 1,406 Naval recruits operated on for inguinal hernia. Different series of patients were operated on with catgut, with fine silver wire and catgut, and with cotton sutures. The use of cotton gave such strikingly superior results that it was adopted as a routine.

Jones (S. G.) aptly remarked that recurrences will occur regardless of the suture material employed. Cordoba observed that failures follow any operation.

**Percentage of Recurrence in Direct Hernia**—The percentage of recurrence in direct hernia operations is 10 to 20 per cent in the hands of the most experienced operators. Many surgeons report it to be between 25 and 50 per cent. Erdman reported 313 direct hernia operations at the New York

Hospital with 52 recurrences (18 per cent) Druce reported 21.4 per cent recurrences following the Bassini operation in difficult inguinal hernias

**Operation for Recurrent Direct Inguinal Hernia**—It is advisable to excise the skin scar, and then to deepen the incision to the aponeurosis of the external oblique, making sure the cord has not been placed superficial to the aponeurosis. Next carefully incise the aponeurosis and locate the cord the ilioinguinal and iliohypogastric nerves and the hernial sac. The sac is freed and ligated as high as possible. The method of closure depends on whether the hernia is indirect or direct. The Cooper's ligament operation is suitable for indirect hernia but the operation for direct hernia is a different technique. Both types of operations are fully described in Chapter XVI The Operations for Inguinal Hernia (igs 123 124 125)

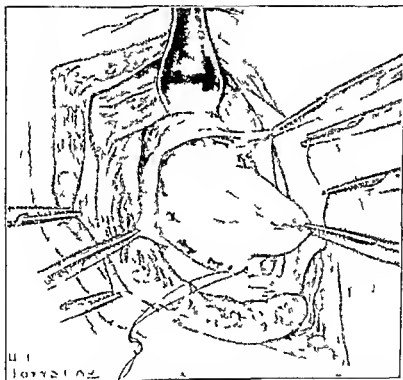


Fig 123.—Operation for large direct inguinal hernia. A purse string suture is placed as high as possible and tied as the sac is reduced. Often a second or reinforcing purse string is advisable.

**Point of Recurrence After Bassini Operation for Indirect Hernia**—In direct inguinal hernias most frequently recur through the opening left for the cord occasionally they come through the deep suture line just above the pubis and rarely through the middle of the deep suture line or a weak spot in the muscles or fascia. Burman reported 62 hernias that recurred after the Bassini operation. In 20 the hernia came through the opening left for the cord while in 37 it appeared in the deep suture line. Schwartz (J) examined 207

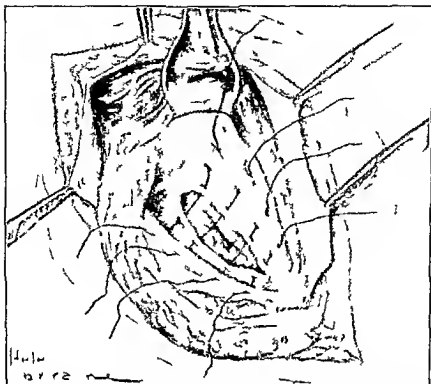


Fig 124.—Operation for large direct inguinal hernia. Suture of the transversalis fascia to the inguinal ligament.

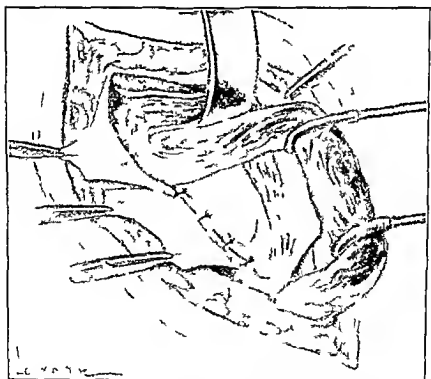


Fig 125.—Operation for large direct inguinal hernia. Deep sutures tied.

patients one to eleven years after operation for inguinal hernia by the Bassini method and found 11 recurrences (53 per cent)

Mair in 1945 found in the literature over seventy modifications of the Bassini operation alone. He remarks that many of these are almost identical and were claimed as original by their designers unaware that other surgeons in earlier years had carried out the same modification and found it wanting. Nearly all endeavored to strengthen the union between the conjoined tendon and the inguinal ligament and to obliterate or change the course of the internal inguinal ring.

Wilmoth reported the records of 2586 patients operated on for inguinal hernia. Of these, 166 or 6.3 per cent, had been operated on once or more than once before, for the same inguinal hernia. Ricketts collected from the literature 6027 operations for inguinal hernia performed by 34 surgeons. In this series there was a recurrence of 5.58 per cent. Iamers reported 511 indirect hernia operations by the Bassini method with 20 (3.9 per cent) recurrences, in 102 direct hernia operations by the Bassini method he found 29 (28.4 per cent) recurrences. Maudsl noted a recurrence rate of 10 to 12 per cent.

**Percentage of Recurrence in Indirect Inguinal Hernia**—The number of indirect inguinal hernias that recur following operation varies from 5 to 10 per cent, depending on the age of the patient and the choice of operation. Recurrence is lowest in those patients between the ages of ten and forty-five years.

Grace and Johnson in reporting the results of operation in patients over fifty years of age state that in 125 patients with recurrent inguinal hernia the results were as follows: indirect, 30 per cent of recurrence; direct, 38 per cent of recurrence. Of the primary inguinal hernias that recurred after operation single indirect operation showed a recurrence rate of 18 per cent, bilateral indirect operation gave a recurrence of 25.2 per cent; direct and indirect operation on one side recurred in 23 per cent while bilateral operation for indirect and direct gave a recurrence rate of 37.2 per cent. In a total of 659 patients over fifty years of age operated on at the Hospital for Special Surgery, New York, there were 170 recurrences or 25.8 per cent.

Cattell and Anderson stated that there was 11.7 per cent of recurrence following the fasci lata operation for hernia. In bilateral hernia operations the recurrence rate was 18.1 per cent. Cowell stated that the average number of recurrences following operation is 3 to 8 per cent for indirect inguinal hernia, 16 to 25 per cent for direct inguinal hernia and 9 to 14 per cent for femoral hernia. Chipman secured good results with strips of aponeurotic fascia.

Stephens has called attention to a generally overlooked fact that when indirect hernias recur they sometimes come through the mid portion of the inguinal ligament and are mistakenly diagnosed as femoral hernia.

It is impossible to believe that the numerous operations proposed for inguinal hernia are without merit or value in certain cases yet much depends on the judgment and experience of the surgeon.

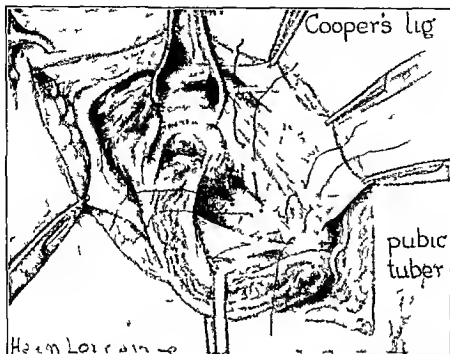


Fig 1<sup>st</sup>—Cooper's ligament operation for recurrent hernia Transversalis fascia sutured to Cooper's ligament Rectus fascia sutured to periosteum and fascia of pubic ramus

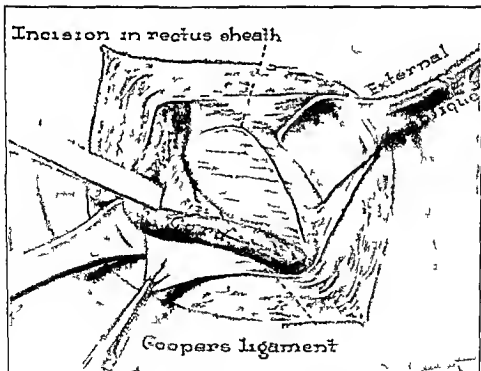


Fig 1<sup>st</sup>—The fascia flap operation The incision in the rectus sheath

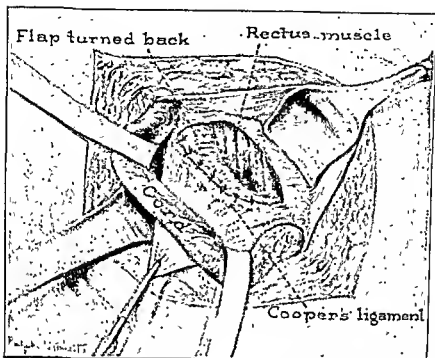


Fig. 128.—The fascia flap operation. The flap is turned back and sutured to Cooper's ligament.

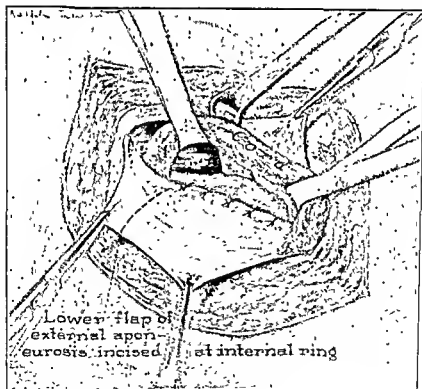


Fig. 129.—The fascia flap operation. The lateral flap of the aponeurosis of the external oblique is incised so as to fit securely around the cord at the internal inguinal ring.

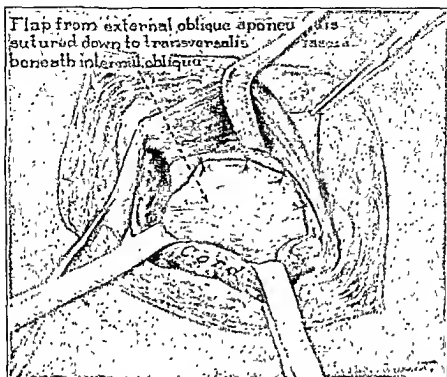


Fig. 130.—The fascia flap operation. The lateral flap of the aponeurosis of the external oblique is carried under the cord and sutured to the transversalis fascia, beneath the internal oblique.

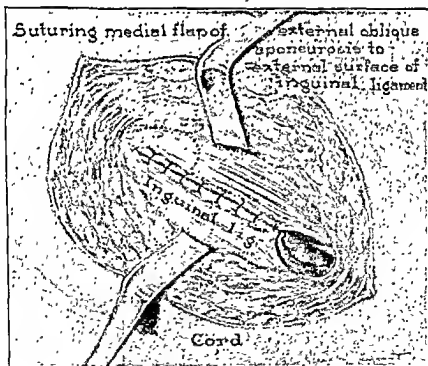


Fig. 131.—The fascia flap operation. The medial flap of the external oblique aponeurosis is brought down and sutured to the inguinal ligament.



In my opinion, the Cooper's ligament operation is the most suitable for indirect inguinal hernia and will give the best results in the hands of the experienced surgeon as well as the occasional operator (Fig 126)

The successful inguinal hernia operation depends on selecting the best method for closing the posterior wall triangle. It is well to bear in mind that each hernia presents a different problem and the technique must be adapted to the condition. For hernias impossible to repair by ordinary methods or fascia grafts McNealy and Glassman advocate the use of a vitallium plate shaped to fit the hernial defect. This material is well tolerated by the tissues and is non irritating.

**Fascia Flap With Cooper's Ligament Operation**—Recurrent indirect inguinal hernia is usually most satisfactorily repaired by the Cooper's ligament operation reinforced with a fascial flap from the rectus sheath. The skin incision is made to the medial side of the internal inguinal ring with excision of the scar of the previous operation (Fig 127). A large semicircular flap of the rectus sheath is dissected from the muscle, turned down and sutured to Cooper's ligament (Fig 128). The lateral leaf of the aponeurosis of the external oblique is slit and notched so as to fit snugly around the cord at the internal inguinal ring (Fig 129). It is then carried under the cord and sutured to the transversalis beneath the internal oblique (Fig 130). The medial flap of aponeurosis is brought down over the cord and sutured to the inguinal ligament (Fig 131). The subcutaneous tissues and skin are closed with interrupted sutures.

### Most Frequent Causes of Recurrence

**1 Failure to Remove All the Sac**—A portion of the sac may be left through careless or incomplete dissection, or a dumbell or funnel shaped process may be left in the peritoneum when the sac is not ligated high enough. Sometimes there is an hourglass constriction of the sac, and the lower portion of the constriction is mistaken for the true neck of the sac, which is actually located 1 to 2 inches (2.5 to 5 cm) higher up.

Patrick, in 1944, investigated the cause in 52 cases of recurrent inguinal hernia. He found that in 33, or 63 per cent, the recurrence was due to incomplete removal or treatment of the sac. Harris believes this factor more than any other is a cause of recurrence.

**2 Faulty Methods of Closure**—Faulty closure of the hernial opening may be due to several causes: failure to make a correct diagnosis, failure to make the cord as small as possible by dissecting off everything but the vas and blood vessels, failure to close the internal ring tightly around the cord, breaking or early absorption of cutgut sutures, too much tension on sutures, failure to suture fascia to fascia, inclusion of red muscle or fat in the deep sutures, failure to check all bleeding resulting in a hematoma in the wound, an attempt to make a standardized technique fit all cases, especially since the routine operation may be inadequate when the fascia is deficient, and failure of the primary operation to repair wholly the original defect.

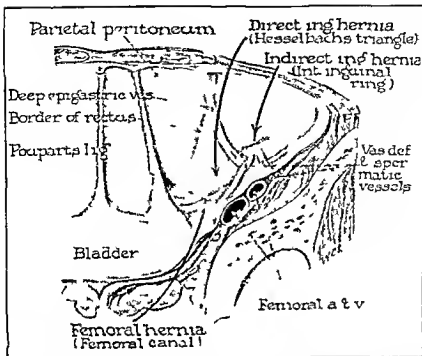


Fig 130—Hesselbach's triangle A posterior view of the inguinal and femoral regions

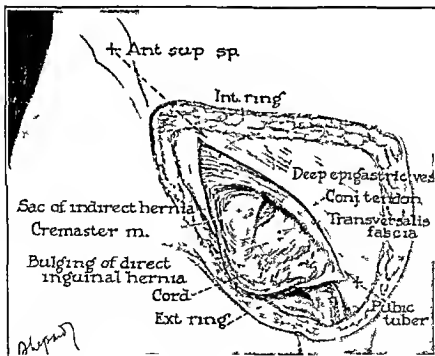


Fig 133—The anatomy of inguinal hernia Showing the relationship of direct and indirect hernias

**3 Inguinal Lipomas**—Fatty masses attached to the sac or cord should be ligated as high as possible and removed. They are most often found in obese subjects and unless they are removed the inguinal canal cannot be closed tightly.

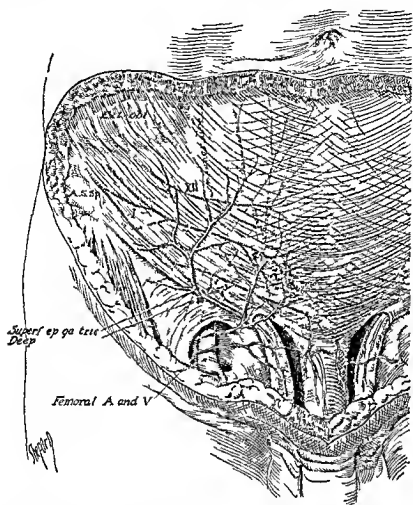


Fig 134.—The superficial anatomy of the inguinal and femoral regions. Showing the muscles and fasciae and the course of the blood vessels and nerves encountered during the operation for inguinal and femoral hernia.

**4 Double Saddlebag or Pantaloon Sacs**—Double sacs are the cause of recurrence more often than is generally supposed. These sacs may be left for one of the following reasons. In direct hernia the operator may overlook the indirect sac which is nearly always present and should be removed. In indirect hernia he may overlook a direct sac which is sometimes present. Both indirect and direct hernias may have bilocular sacs and unless both of these loculi are found and removed the hernia will remain uncured. Campbell believes this is an important factor in recurrent hernia.

The surest way to locate these double sacs is to do the operation under local anesthesia because after the first sac is found if there is another one it will

appear when the patient is directed to cough. In every hernia operation the index finger should be passed through the ring and the peritoneum should be carefully examined for weak spots in the abdominal wall or for beginning hernias (Figs 132 and 133)

**5 Postoperative Rest**—The average recurrent hernia patient insists on getting around soon after his operation, and does not take a sufficient amount of rest before returning to his work. Patients who have had operations for recurrent or direct hernias should avoid any kind of heavy work. Often they should be advised to change their occupation.

**6 Poorly Developed Musculature**—Deficient muscular development favors recurrence especially in direct hernia. This is caused by obliteration or thinning of the transversalis fascia and conjoined tendon, extreme loss of weight resulting in muscular atrophy. Dowden advised systematic exercises to develop the muscles and lessen recurrence. Turner (P) called attention to the secondary weakness of the muscles and fascia caused by pressure from the hernia as an important factor favoring recurrence.

**7 Obesity**—The obese patient is more liable to recurrence than the thin one because the adipose tissue causes a weakening and thinning of the muscles and the intraabdominal tension which is high before operation increases as the patient takes on weight after the operation.

**8 Blood Supply**—The unnecessary cutting of blood vessels is to be avoided as it interferes with the nutrition of the tissues during the process of repair. Cubbins called attention to the ill effects that may follow a too extensive dissection of the upper and under surfaces of the flaps of aponeurosis of the external oblique muscle.

**9 Division of the Nerves**—The iliohypogastric and ilioinguinal nerves supply the muscles in the inguinal region and if they are divided the weakened muscles atrophy and bulge and recurrence is probable. The preservation of the iliohypogastric nerve is especially important as it supplies the internal ring.

**10 Suture Material as a Cause of Recurrence**—Recurrence is frequently due to the irritation inflammation and early absorption of catgut sutures. Silk or cotton not only insures a smoother convalescence but also lessens the

HAWK AND FURCH	NO. OPERATIONS	PER CENT RECURRENT
Indirect inguinal hernia		
Silk or cotton	110	3.6
Catgut	20	11.5
Direct inguinal hernia		
Silk or cotton	95	8.0
Catgut	49	17.3

BURTON AND FAMOS	RECURRENT	PER CENT
40 operations (Bassini)—catgut	31	12.8
457 operations—silk	34	7.5
14 operations—Gale fascia	0	14.2

PAPSONS	PER CENT RECURRENT
244 operations—catgut	12.7
458 operations—silk	3.5

chance of recurrence of the hernia. Quigley noted that in operations on elderly patients the recurrence rate was three times as great with catgut as with silk sutures. Hawk and French also wrote on the marked superiority of silk and cotton. Manzaniilla secured the best results with silk or nylon.

I am in accord with Burdick who stated that the silk technique gives less infection and lower recurrence than the catgut and silk sutures are superior to fascia lata for small direct and recurrent hernias. Babcock stated that infection and recurrence are higher with fascia than with catgut.

Jenkins and Dunham have demonstrated that catgut tanning fluids are potent tissue irritants and may account for much of the blame that has been placed on the catgut itself as a tissue irritant and a cause of tissue necrosis.

Wangensteen believes that most recurrences are due to one of the following causes: (1) use of absorbable suture (2) poor anatomical repair. Glenn states that in 1545 hernia operations at the New York Hospital fascial sutures were never used. Cooper lists the disadvantages and dangers of metal filigrees.

**11 Poor General Health**—Patients with depleted vitamin C are poor risks. Anemia, hemophilia, bronchiectasis, chronic cough, debility, advanced age and very low or high blood pressure are also unfavorable factors.

**12 Bilateral Hernia Operations**—The general practice of operating on bilateral inguinal hernia at the same time adds to the danger of recurrence regardless of the reports to the contrary from a few surgeons. I believe the incidence of recurrence is increased approximately 10 per cent in patients with bilateral operations. Slinner and Duncan place the increase in recurrence rate at 13.5 per cent for bilateral operations. West and Cupp reported 25 per cent recurrence in bilateral indirect hernia operations and 33.33 per cent in bilateral direct inguinal hernias. It stands to reason that the hazard is increased in bilateral operations if one observes that almost invariably the second operation wound is more difficult to close than the first one.

**13 Asthma**—Asthmatics are generally poor operative risks for hernia. As a rule one should wait until the asthma is under control and perform the hernia operation between seasons of the attacks. Coughing exerts a pressure of 100 mm. or more of mercury. This strain is transmitted directly to the abdominal cavity. Pickman and Bayrd found 27 per cent of recurrences of hernia in asthmatics at the Mayo Clinic.

**14 Postoperative Complications as a Cause of Recurrence**—The patients who have an uneventful convalescence without complications are the ones with the lowest recurrence rate. The longer time the operation requires the more frequent are respiratory complications and embolism, especially in the aged. Infections also increase with the length of the operation. Complications are three times more frequent in patients fifty years of age or older than in patients thirty years old or younger. Pulmonary disorders make up about one half of the postoperative complications following hernia operations and this factor plays an important role in recurrence, especially if the patient is advanced in years. Quigley reported twice as many recurrences in elderly patients who developed complications as in those who had a smooth convalescence. Shelley in reporting the results of 2337 hernia operations on

patients of various ages, noted that 246 had postoperative complications, and of these 104 per cent developed recurrent hernias, compared to 72 per cent recurrence in patients who did not have postoperative complications

**15 Recurrence and Intraabdominal Pressure**—Harrison believes that 10 per cent of hernias recur because intraabdominal compensation has been established with little or no safety margin. When we replace in the abdominal cavity the contents of a large hernial sac, the intraabdominal pressure is sufficiently raised to bring it again above the resistance level of the transversalis fascia. Thus, a hernia begins to form again, or perhaps a new hernia develops on the opposite side.

**16 Wound Infection**—Wound infection is comparatively rare at the present time, especially with the skillful use of nonabsorbable suture material. Beekman states that cotton, silk, or nylon have been used for eight years at the Hospital for Special Surgery with less than 0.2 per cent wound infection.

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## CHAPTER XX

### FEMORAL HERNIA

**Synonyms**—Crural hernia, pectineal hernia, microcele, Bichard's hernia, Cloquet's hernia, hernie de Langier

**Definition**—A femoral hernia is a protrusion of abdominal or pelvic viscera through the femoral ring into the femoral canal or beyond it

Femoral hernia is much more frequent in women than in men. Femoral hernia constitutes 97 per cent of all hernias in women and 3 per cent of those in men. Femoral hernia makes up 2.5 of all hernias in both sexes

#### Historical

Femoral hernia was believed to be a variety of inguinal hernia until 1572, when Guy de Chauliac pointed out its differences. In 1665 N. LeQuin wrote that it was more difficult to treat than inguinal hernia. Verheven, in 1699, and Barbette, in 1672, observed that these hernias accompanied the femoral vessels.

Early descriptions of femoral hernia were published by Mauchart, in 1722, Arnaud, in 1748, and de Garengnot, in 1748. These surgeons thought that the sac was situated in front of the femoral vessels although Bassuel, in 1734, had observed that it was located in the angle between the femoral arch and the pubis.

De Gimbernat, in 1768, demonstrated the ligament that bears his name and in 1777 he used his method of dividing the constriction in strangulation for the first time on a living subject. He pointed out that by dividing the constriction (Gimbernat's ligament), the danger of hemorrhage was less than by the old custom of cutting the ring directly upward, a practice which was often followed by fatal hemorrhage. In 1793 he published the first accurate description of the anatomy of femoral hernia.

Cooper, in 1804, made a further study of this subject and described the ligament that bears his name.

Perez Fontana, in 1946, published an outstanding monograph on the anatomy and operative technique of femoral hernia, with a summary of 200 operations he performed for strangulated femoral hernia.

#### Anatomy

The muscles and fasciae of the femoral region are fully described in any textbook on anatomy, and it is unnecessary to consider them here.

**Femoral Canal**—The femoral canal is the narrow space between the femoral vein and the inner wall of the femoral sheath. It is about  $\frac{1}{4}$  to  $\frac{1}{2}$  inch (0.6 to 1.25 cm) long, and transmits the lymphatics from the thigh to the abdomen. The femoral canal is difficult to demonstrate unless the femoral sheath has been separated from the vein by the pressure of a hernia or tumor.



**Femoral or Crural Ring**—The femoral ring is the internal opening of the femoral canal and it communicates with the abdomen. The ring is oval in form and its width is greater than its length. It varies in size being larger in females because the lacunar (Gimbernat's) ligament is narrower, weaker and less securely attached in females than in males. In men the ring is  $\frac{1}{2}$  to  $\frac{3}{4}$  inch (1.25 to 1.85 cm) wide while in women it is  $\frac{3}{4}$  to 1 inch (1.85 to 2.5 cm) wide.

**Boundaries of the Ring**—The femoral ring is bounded on the inner side by the lacunar ligament. This ligament is poorly developed in children and often lies in contact with the femoral vein. The inner boundary also has some fibers from the iliac portion of the fascia lata and from the deep femoral arch. The lacunar ligament is strengthened by Colles ligament and the conjoint tendon. The femoral ring is bounded on the outer side by the femoral vein in front by the inguinal ligament and the deep femoral arch and behind by the horizontal ramus of the pubis which is covered by the origin of the pectineus muscle and fascia.

**Femoral Fossa**—The femoral fossa is a depression in the peritoneum on the inner surface of the abdomen below the inguinal ligament at a point corresponding to the position of the femoral ring.

**Points of Exit of Femoral Hernia**—Femoral hernia usually descends between the femoral vein and the lacunar ligament. Velpeau termed this hernia *hernie crurale majeure*. Femoral hernia may also descend above the femoral vessels and slightly external to them.

Hernia beneath the inguinal ligament external to the femoral vessels is very rare because of the firm attachments of the iliac and transversalis fasciae to the outer half of the inguinal ligament and also because of the resistance offered by the psoas and iliacus muscles and the iliac fascia. The inner angle of the iliopectineal space is equally resistant to the exit of hernia as it is protected by the inguinal ligament, the lacunar ligament and the pectineus muscle and fascia.

**Coverings of Femoral Hernia**—The coverings of a femoral hernia from within outward are (1) extraperitoneal tissue, (2) the septum crurale, (3) the femoral sheath (transversalis fascia), (4) the cribiform fascia, (5) the superficial fascia, (6) the skin.

**Cooper's Ligament**—In 1804 Cooper described the ligament that bears his name and called it the "pubic ligament." It is a strong ligamentous band extending from the tuberosity of the pubis outward above the iliopectineal line and covering the ramus of the pubis. It is composed of thick strong fascia formed by the fusion of the following fascial layers: the pectineal fascia, Colles ligament and the transversalis fascia, the lacunar ligament, the fascia from the margin of the lower attachment of the linea alba, and Henle's and Hesselbach's ligaments.

Lockwood called attention to the strength of Cooper's ligament. He remarked that with a hook beneath the ligament one could lift the pelvis of the cadaver from the table.

**The Sac**—The sac of femoral hernia is a protrusion of peritoneum through the femoral ring. It is usually congenital in origin and may contain any of

the movable abdominal or pelvic viscera. If the sac is small it is often empty on account of the narrowness of the lumen or the constriction at the femoral ring. The mouth of the sac is the part resting in the femoral ring; the neck of the sac is the part lying in the femoral canal; and the body or fundus is the portion outside of the canal.

A femoral hernial sac is usually small and globular in shape. In large hernias it may assume any shape and in rare instances it may extend to the knees.

**Hourglass Sac (Hernie en Bissac).—**An hourglass sac may have two or more prolongations or loculi emerging from the femoral ring either through Gimbernat's ligament or on the surface of the pectineus muscle or through the cribriform fascia or beneath it.

**Double Sacs.**—It is probable that double sacs are formed by reduplication of a peritoneal pouch into an unobliterated congenital diverticulum or there may be two congenital diverticula passing through the femoral ring. Double femoral hernias are rare although several cases have been reported in the literature. Scott operated on a woman aged thirty-seven years with two femoral hernias on the right side. He called attention to the danger of wounding the femoral vessels when one hernia is external to the other.

**Contents of the Sac.**—Omentum is most often found in the sac. Small intestine is seldom present except when strangulated and the following viscera are sometimes found: colon, cecum, appendix, sigmoid bladder and very rarely ovary, fallopian tube, uterus, testis, kidney, gallbladder and liver. When omentum is in the sac it is often adherent to the sac wall to other viscera or it may be the seat of epiploitis.

Ahrens and Spiegel reported cases of incarceration of the stomach in a femoral hernia sac. Seawell operated on a man eighty-three years old for strangulated left femoral hernia. As long as the patient could remember a lump had appeared from time to time in the left groin, remained for a few hours and then disappeared. The appearance of the mass was always accompanied by severe pains in the epigastrium. During the last attack the mass was irreducible for five days; it was the size of a hen's egg, somewhat tender, firm to the touch, immovable and was accompanied by pain and vomiting. At operation the sole content of the sac was a bluish black mass which proved to be an undeveloped kidney. This strangulated kidney was excised without relief of symptoms and the patient died on the fourth day.

I operated on a femoral omental hernia in a woman seventy-nine years old. It had been irreducible for ten years and during this time there had been constant pain in the epigastrium and stomach which was never entirely relieved until the hernia was operated on. Local anesthesia was used and the patient made an uneventful recovery.

Chevrier reported 2 cases in which a loop of the round ligament entered the femoral ring beside the hernial sac. The fallopian tube is a rare content of a femoral hernial sac. Cottu and Kuss reported a case of femoral hernia of a cyst of the round ligament that was the size of a small orange and caused occasional attacks of severe colicky pain and vomiting. Petri encountered

endometriosis of a femoral hernia sac. McCoikle and Bell reviewed the literature on hydrocele of the femoral hernia sac. They found only 5 authentic cases in the literature and added 3 of their own. Shepler and Smith found the tube and ovary in the femoral hernia sac of an infant two months old. Bonn discovered an ectopic testis in a femoral hernia sac, and Sealone found an atrophied ectopic testis in the sac.

**Sac Contents in Strangulated Hernia**—While old irreducible hernias are usually omentoceles, the sac contents of strangulated hernia are nearly always small intestine, often accompanied by omentum. Rarely other abdominal viscera are in the sac. Jens found the following contents in 100 cases of strangulated hernia: small intestine 63, small intestine and omentum 23, omentum only 8, appendix 1, colon, 3, and an empty sac twice.

**Relation of the Femoral Vessels to the Hernia**—In the common variety of femoral hernia the femoral vein is to the outer side of the hernia, and the internal saphenous vein is in front of the hernia and also to the outer side.

**Frequency on the Right and Left Sides**—Inguinal hernia is more frequent on the right side in both sexes. Inguinal hernia occurs with nearly equal frequency on both sides in women, while femoral hernia is nearly twice as frequent on the right side in women. Kolzareff reported 63 cases in women of these 46 were on the right side (32 strangulated) and 19 on the left side (9 strangulated).

**Femoral Hernia Associated With Other Varieties**—Femoral hernia may be combined with one or more hernias in other regions. It is most frequently associated with inguinal hernia. In 10,000 cases of hernia Berger found femoral and inguinal combined in 222 cases of these 203 were in males and 19 in females. In 87 cases there were double inguinal and double femoral hernias.

Umbilical hernia is often associated with femoral hernia alone, or combined also with inguinal hernia. Other varieties of hernia are associated with femoral hernia in isolated cases. (Fig. 135.)

In combined or multiple hernia there is almost always a general relaxation of the abdominal wall and strangulation is less frequent than when the femoral hernia is alone.

**Peritoneal Femoral Hernia**—Peritoneal femoral hernia is very rare. LeClere collected 5 cases from the literature and reported a case of his own. The patient was a woman aged sixty years, the hernia had a bilocular sac.

**Crural scrotal Hernia**—In rare instances inguinal hernia descends into the femoral region instead of into the scrotum. Sometimes it follows an ectopic testis which has descended into the crural region. Gusti reported a case of inguinal and femoral hernia with a single sac. Teeles reported a case of crural scrotal hernia in a man aged fifty-three years in whom a right inguinal hernia descended along the thigh to a point three inches (7.5 cm.) above the patella.

**Constricting Point in Strangulation**—In strangulated femoral hernia the point of constriction is almost always the sharp unyielding edge of the lacunar ligament, rarely it may be in the meshes of the cribriform fascia at the margin of the saphenous opening, or in the neck of the sac.

Blakeway believed, contrary to the usual teaching that the chief cause of strangulation is the narrowness of the neck of the sac, and not the free edge of Gimbernat's ligament. He believed that there is usually a localized thickening of scar tissue at the neck, that is absent in the rest of the sac. I have seen a strangulated femoral hernia which was due to an intraabdominal volvulus.

Previous to the advent of the open operation for strangulated femoral hernia the obturator artery was usually wounded by blind division of the constriction if its course chanced to be abnormal and it passed close to the free edge of the lacunar ligament. Because of the usual fatal outcome this anomalous course of the obturator artery was termed the *corona mortis* or "crown of death."



Fig. 13.—Umbilical and femoral hernia in a man aged fifty-seven years. The umbilical hernia has been present for several years. The femoral hernia was of one month's duration and had appeared after lifting a heavy object.

### Rare Varieties of Femoral Hernia

1 **External Femoral Hernia (Hesselbach's Hernia)**—External femoral hernia passes into the thigh below the inguinal ligament external to the deep epigastric artery and is almost always associated with an inguinal hernia of the same side. External femoral hernia sometimes enters the femoral ring outside of the external iliac artery and spreads out in Scarpa's triangle in front of the femoral vessels. This variety of femoral hernia has been studied by Arnaud, Demereux, Velpeau, Berger, Hesselbach, Bahr, Narath, and others. In the case observed by Demereux there were two sacs, one internal to the deep epigastric artery and the other external to it.

2 **Hernia Through the Lacunar (Gimbernat's) Ligament (Hernie de Laugier, Hernie Crurale Interne—Velpeau)**—Hernia through the lacunar (Gimbernat's) ligament was described by Laugier, in 1833. In this hernia the

sac emerges between the fibers of the lacunar ligament. The hernia is usually small and lies more internal than the ordinary variety. In rare instances it has bilocular sacs, one loculus coming through the femoral ring and the other between the fibers of the lacunar ligament. In 1858 LeGendre collected from the literature 6 cases of this variety of hernia. A number of cases have been reported in the literature since the radical operation has come into use.

**3 Pectineal Hernia (Cloquet's Hernia)**—Pectineal hernia was first observed by Callisen in 1777 and described in detail by Cloquet in 1814. Fasano collected 16 cases from the literature.

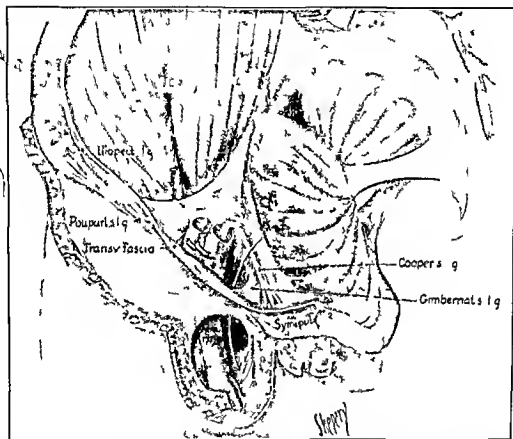


Fig. 136.—The anatomy of femoral hernia. Showing the course of the hernia and its relation to the vessels and to Cooper's and Gimbernat's ligament.

Pectineal hernia enters the femoral canal, perforates the aponeurosis of the pectineus muscle and remains between this muscle and its aponeurosis, simulating an obturator hernia. Pectineal hernia is probably due to an abnormal insertion of the pectineal fascia. (Fig. 136.)

**4 Retrovascular Hernia**—The sac of retrovascular hernia follows the femoral sheath downward. Serafini reported a very rare case in which the hernia descended behind the femoral vessels inside the sheath of the femoral vein. Diagnosis was confirmed at autopsy.

**5 Prevascular Hernia**—In prevascular hernia the sac is situated in the femoral sheath but in front of the vessels, I believe this variety of hernia is more frequent than is generally supposed. Narath reported 6 cases of traumatic prevascular hernia following reduction of congenital dislocation of the hip, Moschcowitz has written extensively on this subject and Cevario has considered this variety of femoral hernia in detail. A number of cases are reported in the literature.

**Multilocular Sac (Cooper's Hernia)**—After the sac emerges at the femoral ring it may divide into loculi that pass in one of the following directions through the femoral canal toward the obturator foramen and in rare instances, a third loculus which is peritonoeal may pass into the labium majus or the upper part of the scrotum. I recently observed a femoral hernia in a woman in which one loculus passed into Scarpa's triangle and the second one passed upward onto the external oblique aponeurosis.

### Etiology

**Saccular or Congenital Theory**—The congenital origin of femoral hernia is generally accepted today. The hernia enters a preformed pouch or diverticulum which has failed to become obliterated. In 200 consecutive postmortem examinations reported by Murray peritoneal femoral diverticula were found in 52 subjects; in 14 of these the sac was bilateral. Femoral diverticula were found more frequently than inguinal diverticula; in the 200 subjects potential inguinal sacs were found in 13 cases and in 4 of these the sac was bilateral. Keith found femoral diverticula more frequently in adult subjects than Murray did.

McCorkle and Bell believe that femoral hernia sacs are probably congenital. Shepler and Smith reviewed the subject of femoral hernia in infancy and agree that they are congenital in origin.

**Frequency of Femoral Hernia on the Right and Left Sides**—Femoral hernia is usually single and appears most often on the right side. When it is bilateral the hernia on the right side is usually the larger.

Femoral hernias are nearly always found in women, 97 per cent in females and only about 3 per cent in males; however it is only slightly more frequent in women who have not borne children than in men. Femoral hernia rarely occurs before the twentieth year.

Seley, in 1941, stated that in 213 cases of femoral hernia 167 were women and 46 men. McClure and Fallis reported 4530 inguinal hernia operations compared to 90 operations for femoral hernia and they conclude that the ratio is approximately fifty to one. Waugh and Hausfeld in a series of 515 hernia operations found one femoral to 31 inguinal hernias. Wilmoth, in 2824 hernia operations reported 63 femoral hernia to 2761 of the inguinal variety.

**Infants and Children**—Femoral hernias are rare in infants and children. They usually occur between the tenth and twelfth years and are generally single very seldom double. They ordinarily develop gradually and are not

recognized at first. Sex has little influence. Ribera and Sans reported 764 hernias in 6777 infants examined. Only six hernias were femoral, 3 in males and 3 in females.

While femoral hernias are almost unknown in infants and children they are slightly more frequent in males but after the age of twenty years they affect females with increasing frequency.

**Anatomic Causes**—The anatomic conditions that predispose to the development of femoral hernia are: a preformed sac, prominence of the peritoneal depression due to lack of fat, absence of the lymph gland of Rosenmüller and a large sphenous opening or a large compressible femoral vein. Joessel believed that an open femoral ring is an important factor.

Other predisposing causes are pregnancy, parturition, emaciation, increased intraabdominal tension due to obesity or tumors and relaxation of the femoral ring in the aged.

**Femoral Hernia Developing After Operation for Inguinal Hernia**—Femoral hernia occasionally appears after an operation for inguinal hernia. It is probable that the increased intraabdominal pressure following the operation forces the omentum or intestine into a preformed femoral sac. Femoral hernia as well as any other variety of hernia may develop after any abdominal operation.

Inguinal hernia sometimes occurs after an operation for femoral hernia. The inguinal hernia is usually indirect when the femoral hernia has been operated on by the femoral route, and direct when the femoral hernia has been operated on by the inguinal route.

When femoral hernia follows an operation for inguinal hernia it is probably due to the pulling upward of the inguinal ligament by the deep sutures of the inguinal hernia operation which increases the size of the femoral opening. In operating for inguinal hernia it is sometimes advisable to stitch the conjoint tendon to Cooper's ligament when the inguinal ligament is lax or deficient to prevent the secondary development of femoral hernia.

**Femoral Hernia and Pregnancy**—As pointed out by Cooper, reducible femoral hernia usually disappears in the latter half of pregnancy and does not recur until after parturition.

**Femoral Hernia and Tuberculosis**—The association of femoral hernia and tuberculosis is fairly frequent. The resistance of the tuberculous patient is seriously impaired by the symptoms of femoral hernia such as colic, nausea, digestive disturbances and partial or complete strangulation. Marked improvement in pulmonary tuberculosis has often followed the cure of the hernia by operation.

### Symptoms and Diagnosis

Femoral hernias are usually small and seldom contain intestine and for this reason the symptoms are less marked than those in inguinal hernias. Small femoral hernias are liable to be overlooked in obese subjects.

**Functional Symptoms**—The functional symptoms are not pronounced unless the hernia is large or contains abdominal viscera. Adherent omentum may

cause a dragging pain referred to the lower abdomen. If intestine is in the sac the pain may be colicky, with symptoms of obstruction. Strangulation is frequent and may be partial or complete, accompanied by very severe pain.

As early as 1721, Koch described a numbness or sense of weight in the thigh as a symptom of femoral hernia. Sometimes there is edema of the extremity, due to compression of the vein by the hernia. These symptoms are not always present and are easily overlooked. Pain radiating down the thigh is more often associated with obturator hernia than with femoral hernia. If femoral hernia contains intestine, a gurgling sound may be heard on reduction. Other symptoms may be referred to the viscera in the sac. Irreducible femoral hernia containing the ovary and tube, especially in infants and children, has often been diagnosed and operated on as strangulated femoral enterocele.



Fig. 137.—Femoral hernia of three years duration in a man aged thirty years. (A) The hernia will remain reduced with the patient in the standing position. Also left inguinal hernia. (B) The hernia appears after a strain or cough.

**Objective Signs.**—Femoral hernia nearly always appears as a small globular tumor, just below the inguinal ligament. It is usually smaller than a hen's egg, although sometimes it may attain the size of an adult's head and may extend down the thigh as far as the knee or below it. On account of the small size of the ring, femoral hernia usually reduces very slowly. (Fig. 137.)

### Complications

**Strangulation.**—Strangulation is eight to ten times more common in femoral hernia than in inguinal hernia. Partial strangulation or Richter's hernia, in which only part of the lumen of the intestine is nipped by the femoral ring, occurs more often in femoral hernia than in any other variety.

Because the obstruction is incomplete, the symptoms are sometimes indefinite and misleading, but usually one or more of the following symptoms will be present: nausea, vomiting, colicky pains often associated with tympanites, and profound shock. In strangulated femoral hernia the tumor is often small. Sometimes the only sign of its existence is a tense tender point



and a slight fullness just internal to the femoral vessels. In certain cases the diagnosis is made during the operation for supposed intestinal obstruction. On account of the unyielding constricting wall, gangrene occurs early in strangulated femoral hernia.

**Frequency of Irreducibility and Strangulation** Irreducibility and strangulation are frequent complications of reducible femoral hernia. Nearly 50 per cent of the old femoral hernias that come for operation are either irreducible or strangulated. Persson reviewed the femoral hernia operations at St. Thomas' Hospital and found the occurrence of irreducibility and strangulation as follows:

MALES			FEMALES		
TOTAL CASES			TOTAL CASES		
140 unilateral		140	33 unilateral		347
7 bilateral			18 bilateral		
REDUCIBLE	IRREDUCIBLE	STRANGULATED	REDUCIBLE	IRREDUCIBLE	STRANGULATED
80	46	14	158	110	84
Total	Reducible	34	Irreducible	141	Strangulated 111

**Reduction en Masse**—Taxis should be used very carefully in strangulated femoral hernia. On account of the small unyielding ring there is small prospect of success. Taxis should be limited to gentle pressure with stroking of the hernial mass downward and inward to straighten the hernial sac and decrease its angulation. The patient should be in the Trendelenburg position to give the best prospect of success. Only a few minutes should be devoted to taxis before an operation is undertaken. Reduction en masse is a rare complication of femoral hernia and should be suspected when there are symptoms of internal strangulation and history of a femoral hernia that no longer descends through the femoral ring. Casten and Bodenheimer reviewed the literature on strangulated femoral hernia reduced en masse and collected 207 cases and also reported two of their own, one in a man and the other in a woman.

**Displaced Strangulated Hernia**—Displacement of a strangulated femoral hernia from its usual position in the upper part of Scarpa's triangle is almost always due to forcible taxis. The hernia may be displaced by reducing it en masse through the femoral ring or by forcing it through a rent in the femoral sheath into the connective tissues of the thigh. When this accident happens the hernia may appear somewhere below or above the inguinal ligament. Shields reported a case in which unsuccessful taxis displaced a strangulated femoral hernia to a position up over the inner third of the inguinal ligament where it closely resembled a strangulated inguinal hernia. Bryant observed a case in which taxis forced a femoral hernia through a rent in the femoral sheath at the inner side of Scarpa's triangle. At operation the site of strangulation was found in the tear in the femoral sheath.

**Femoral Hernia Accompanied by Appendicitis in the Hernial Sac**—Some times the appendix is found in a femoral hernial sac. A number of cases have been reported in the literature in which operation was undertaken for strangulated hernia and when the sac was opened only a gangrenous appendix was found. The symptoms of this complication are often misleading. In a case

observed by Doolin, there was a small, tender, painful swelling in the upper and inner angle of Scarpa's triangle, there was no tenderness or rigidity above the inguinal ligament. The femoral sac was distended with pus and contained only a gangrenous appendix.

### Differential Diagnosis

**Reducible Femoral Hernia**—The conditions most frequently mistaken for reducible femoral hernia are incomplete reducible inguinal hernia, saphenous varix, and psoas abscess.

**Incomplete Reducible Inguinal Hernia**—An incomplete inguinal hernia is sometimes mistaken for a femoral hernia that passes upward toward the inguinal ligament. If a line corresponding to the inguinal ligament is drawn from the spine of the pubis to the anterior superior spine of the ilium, the inguinal hernia will lie above this line, while the femoral hernia will be below it.

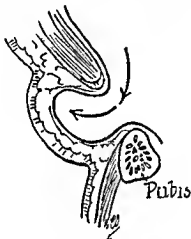


Fig 138—Schematic drawing. After the hernia reaches the femoral region it often passes upward on to the aponeurosis thus simulating an inguinal hernia.

The inguinal hernia can be reduced by making pressure upward, outward and backward, and pressure over the inguinal canal will prevent its descent. Femoral hernia is reduced by pressure downward, backward, and upward and returns to the abdominal cavity very slowly.

In direct inguinal hernia the direction of reduction is backward and upward, and reduction is much quicker than with femoral hernia. Inguinal hernia can ordinarily be reduced with the patient in the erect position, while with femoral hernia it is usually necessary for the patient to lie down.

In differentiating reducible inguinal hernia from reducible femoral hernia the three important landmarks are the pubis, the femoral artery, and the spermatic cord. Cases are on record in which an operation has been done for inguinal hernia, and the mistake in diagnosis discovered only after the patient was out of bed. When the diagnosis between inguinal and femoral hernia is difficult or impossible, the hernia is usually femoral (Fig 138).

**Saphenous Varix**—The differentiation of saphenous varix from inguinal and femoral hernia was first described by Bonnet in 1836. A saphenous varix

disappears when the patient lies down, no pressure being required to reduce it and its reappearance when the patient stands up can be prevented by making pressure over the femoral canal. There is no gurgling on reduction and a humming murmur is heard on auscultation. A characteristic thrill is felt over the varix when the patient coughs. The only other condition that resembles saphenous varix is hernia associated with ascites. The symptoms of dilatation of the upper portion of the saphenous vein are the same as those of saphenous varix. The skin over the saphenous varix is bluish if there is no subcutaneous fat, if the fatty tissue is abundant no difference in color can be detected. The varix is usually about one half inch (1.25 cm.) below the saphenous opening. In 10 cases of saphenous varix collected from the literature by Richardson 7 were diagnosed before operation as strangulated or incarcerated femoral hernia. Saphenous varix should be treated by injection or by ligating the vein above and below the varicosity and the dilated portion excised. (Fig. 139.)



Fig. 139.—Varicose femoral veins are sometimes mistaken for femoral hernia. This patient, seventy-two years of age, has bilateral indirect inguinal hernias and a large left saphenous varix.

**Varicose Veins**—Varicose veins in the labium majus may be present during pregnancy and are not to be confused with femoral hernia.

**Psoas Abscess**—When psoas abscess descends into the thigh it usually appears as a symmetrical fluctuating mass which transmits an impulse on coughing and is reducible without a gurgling sound. A tumor can be felt above the inguinal ligament. The spine should be examined for tuberculosis which will almost always be found and is the source of the abscess.

**Obturator Hernia**—Obturator hernia may rarely be mistaken for femoral hernia. Examination of the femoral canal will show that it is empty. (The symptoms of obturator hernia are described elsewhere.)

**Irreducible Femoral Hernia**—The conditions most frequently mistaken for irreducible femoral hernia are femoral adenitis and lipoma.

*Femoral Adenitis*—Adenitis in the femoral region gives no impulse on coughing, and usually several enlarged glands can be felt. Sometimes a small strangulated femoral hernia is mistaken for a broken down lymph gland, especially after the intestine has perforated and the sac is tender, painful and fluctuating. Occasionally, a femoral adenitis overlies a strangulated hernia. Ross reported a case in which he incised the suppurating lymph glands and found beneath them a small mass which proved to be a strangulated femoral hernia.

*Femoral Lipoma*—A lipoma in the femoral region gives no impulse on coughing. It usually lies external to the saphenous opening, and below it, and the femoral canal is empty. A lipoma can be lifted up with the skin to which it is adherent. When it is situated in front of a femoral hernia, it must not be mistaken for adherent omentum in the sac. Strangulated lipoma closely resembles a strangulated hernia. As a rule, the hernia is less movable than the lipoma.

*Other Conditions to Be Differentiated*—Other conditions that may be mistaken for femoral hernia are cysts, fibromas, newgrowths in the femoral region, distended psoas bursae, hydatid cyst, dermoid cysts, muscle hernia of adductor longus, strangulated obturator hernia lying behind a reducible femoral hernia, and aneurysm of the femoral artery. In the last named condition, there is an impulse over the tumor synchronous with the radial pulse.

A lymphocele in the femoral region may simulate an irreducible hernia. If small, it may be mistaken on palpation for a lipoma. In the tropics filarial lymphoceles are not uncommon.

*Diagnosis of Strangulated Hernia*—Strangulated femoral hernia has been mistaken for almost every disease causing abdominal pain. The symptoms are often so vague and indefinite that the possibility of a strangulated hernia is overlooked and thus the diagnosis is delayed. This applies especially to the small hernia or one that is not palpable with symptoms referred to the epigastrium, with little or no pain or tenderness over the hernia. Diagnosis is most often delayed in the aged patient with slight symptoms or an old hernia that has been irreducible for months or years.

McNealy and Lichtenstein stated that 404 femoral hernia patients were admitted to Cook County Hospital in a nine year period, and 225, or 55.7 per cent, were strangulated or incarcerated. Six of these died before operation could be undertaken.

McClure and Falls reported 90 femoral hernia operations, 23.3 per cent were strangulated.

Dunphy observed that because of errors in diagnosis, surgical intervention was delayed from one to eight days in 70 per cent of the fatal cases he studied.

*Roentgen Ray Examination*—Marti and Cottet report a rare case of strangulation and perforation of a Meckel's diverticulum in a left femoral hernia. They point out that when other methods fail, a diagnosis may be made before operation by a careful roentgen-ray examination.

### Prognosis

The prognosis of untreated femoral hernia is grave. Strangulation is eight to ten times more frequent in femoral hernia than in inguinal hernia. Truss treatment is dangerous as there is no prospect of a cure by this means, and usually a truss cannot be fitted to femoral hernia so as to retain it safely. If the hernia slips by the truss pad, there is great danger of strangulation. The cause of the high percentage of strangulation in femoral hernia is due to the sharp unyielding edge of the lacunar ligament, which forms the inner boundary of the small femoral ring, and the direction of descent of the hernia, which is downward, forward and upward.

The radical operation or the injection is the only treatment to be recommended for femoral hernia. In the nonstrangulated variety, the operation or the injection is followed by a high percentage of cures. In strangulated femoral hernia the mortality rate is higher than that in strangulated inguinal hernia, because gangrene occurs earlier in femoral hernia and the patient comes to operation later, on account of the difficulties of diagnosis.

### Treatment

The radical operation is the treatment of choice for strangulated and large nonstrangulated femoral hernia. Mechanical treatment is unsatisfactory, dangerous, offers no prospect of a cure, and is to be employed only when operation is refused or contraindicated.

**Mechanical Treatment**—Small reducible femoral hernias offer the best prospect of being held by a truss. The method of measuring for a truss is the same as that described for inguinal hernia. In the femoral truss the frame from the shoulder to the pad is more oblique than in the inguinal truss, and the pad is smaller. A water pad is the most comfortable. The cross body type of frame truss is satisfactory. The elastic truss with a molded pad and thigh strap is the best.

Even when a truss that will control the hernia can be fitted, it is easily displaced because the point on which it presses does not remain fixed. The movements of the muscles of the upper anterior portion of the thigh, in any form of exercise, tend to displace the truss upward. The truss treatment for femoral hernia causes the patient more inconvenience and discomfort than the truss treatment for inguinal hernia. For these reasons the operative treatment is always to be recommended. The prospect for a cure is excellent, and the percentage of recurrence is even lower than that in the inguinal variety. Irreducible femoral hernia almost always consists of omentum and should be treated by radical operation. In strangulated femoral hernia, immediate operation is imperative because of the early onset of gangrene.

The ideal operation removes the sac, closes the femoral opening firmly, and still does not weaken the inguinal canal or rings. The operative treatment of femoral hernia is closely associated with the development of the inguinal hernia operation, and practically all the operations for inguinal hernia have been used at one time or another for the cure of femoral hernia.

### Historical Review of the Operation for Femoral Hernia

In earlier days division of the constricting femoral ring with a knife was considered so dangerous on account of possible injury to the femoral vessels that Thevenier in 1669 devised a two branched dilator, which was also advocated by Le Blanc in 1767. Arnaud in 1748 made an advance in the surgery of strangulated femoral hernia by advocating the stretching of the femoral ring with a crochet hook, and his results were the best attained up to that time. During the past century the treatment of femoral hernia made only slight progress. Treatment was confined to strangulated femoral hernia, and the herniotomy operation was limited to cutting Gimbernat's (Peyrussat) ligament and leaving the intestine untreated. The result was that the patient nearly always died of peritonitis. If he survived he had a serious fistula to sap his strength. Lister, in 1871, introduced his new antiseptic surgery method, and operations for femoral hernia took a turn for the better, and for the first time the mortality rate in strangulated hernia improved. Since Lister's day nearly two hundred operations have been advocated for femoral hernia. Too often the surgeon who publishes a new operative procedure does not have the time or the facilities to review the literature that has gone before and as a result he believes that the "new" operation is original with him.

This brief historical summary has been compiled for the student who is interested in the development of the modern operations for femoral hernia. Space does not permit a description of them, but many have much merit and are invaluable to meet special conditions encountered in femoral hernia operations.

For those planning new operations it might be of interest to mention briefly a few of the numerous operative procedures that have been carried out by surgeons in the last seventy five years. Often the surgeon has employed a particular operation for some years before publishing his technique.

**Methods That Do Not Remove the Sac But Use It as a Plug for the Canal**—These operations are among the earliest for femoral hernia, when it was the general belief that plugging the canal would cure the hernia. Bouchet (1878), Macewen (1886), Lockwood (1889), Bishop (1890), Billroth (1893), Kocher (1897), Ferguson (1907), Dowden (1918), Melville (1935).

**Methods That Do Not Close the Canal**—These methods are not in general use as the recurrence rate is too high. Socin (1879), Banks (1882), Ochsner (1892), La Roque (1922), Wangh and Hansfeld (1942).

**Methods That Close the Femoral Canal by Muscle, or Muscle and Fascia Transplants**—These myoplastic operations are no longer in use as they have been supplanted by fascia sutures alone. Novaro (1892), Giordano (1892), Cheyne (1892), Salzer (1893), Moullin (1896), McArdle (1899), Prokunnin (1900), Ghaput (1900), De Garay (1903), Polya (1905), Gobell (1913), Hofmann (1921), Grissey (1926).

**Methods That Close the Femoral Canal With Transplants of Periosteum or Bone Grafts, Staples or Sponge**—Heteroplastic operations are only of historic interest at this time and are no longer used in femoral hernia operations.

Kraske (1883), Ball (1884), Tiendelenburg (1890), Thuriar (1893), Jabonlay (1896), Platt (1897), Mikulicz (1897), Borchardt (1898), Chaput (1900), Herzen (1903), Triani (1905), Ferguson (1905), Sick (1911), McLennan (1921)

**Methods That Close the Femoral Canal by Suturing the Inguinal Ligament to the Pubic Bone**—These early operations are not considered satisfactory Roux (1898), Nicoll (1902), Cavazzini (1903), Hammesfahr (1904), Andrews, A (1928)

**Methods That Use Silver or Steel Wire Filigree**—These methods are no longer used for femoral hernia repair Witzel (1890), Bartlett (1903), Goepel (1900), McGavin (1909), Andrews, A (1927)

**Methods That Divide the Inguinal Ligament and Suture the Canal**—This type of early operation is only of historic interest Delagénière (1896), Fabricius (1907)

**Methods That Close the Canal Through a Laparotomy Incision**—This procedure is not in general use because the inguinal operation gives a better exposure of the femoral hernia Tait (1883), Lued (1908), Beckman (1912), Cheate (1920), La Roque (1922), Savini (1922), Soren (1923), Henry (1936)

**Methods That Close the Femoral Canal With a Purse String or Mattress Suture**—This group of operations did not provide a firm closure of the femoral ring and are suitable only for very small hernias Wood (1883), Cushing (1888), Langenbeck (1888), Bottini (1891), Tuccini (1891), Berger (1892), Marey (1892), Blake (1906), Coley (1906), Kummer (1912), Noble (1913), Warhuse (1919), Morison (1928)

**Methods That Close the Femoral Canal With Interrupted Sutures**—Closure of the femoral canal with interrupted sutures is favored by many surgeons, especially when there are no signs of strangulation of intestine Barker (1887), Berger (1892), Billioth (1893), Frey (1893), Bassini (1893), Fowler (1897), Lucas Championnière (1898), Parry (1901), Bacon (1901), De Garmo (1905), Baldwin (1906), Battle (1908), Buckley (1914), Keynes (1927), Kellogg (1928)

**Methods That Close the Canal Through an Inguinal Incision Approach**—The inguinal operation for femoral hernia is most generally used by surgeons at the present time Annandale (1875), Ruggi (1892), Parlavacchio (1893), Tuffier (1896), Lotheissen (1898), Codvilla (1898), Gordon (1900), Parry (1901), Bennett (1903), Guba and Proust (1904), Kammerer (1904), Marro (1906), Moschcowitz (1907), Wilms (1911), Dujarric (1912), Morton (1912), Seelig and Tubolske (1914), Landry (1918), Groves (1922), Andrews, E (1924), Cowell (1927), Easton (1933), Gutiérrez Santacruz (1935), Melville (1935), Dickson (1936), Christopher (1937), Wilmoth (1937), Ottobruni Costa (1939), McVay (1939), Gutiérrez (1942), Rees (1942), Harkins (1943), Homans (1945)

**Methods That Close the Femoral Canal With Fascia Sutures**—Fascia sutures are difficult to apply in femoral hernia operations. Most surgeons prefer silk, linen or cotton McArthur (1901), Wilms (1911), Pettit (1924), Payne (1935), Collins, D C (1938)

### Inguinal Operation for Femoral Hernia

**Closure of the Femoral Ring Through the Inguinal Canal**—The inguinal operation for femoral hernia was first employed by Annandale in 1876. While operating on a patient who had an inguinal and femoral hernia on the same side, he discovered that the femoral hernial sac was easily located and the hernia easy to reduce through the inguinal incision. He sutured the inguinal ligament to Cooper's ligament and then closed the inguinal wound. The following year he used the inguinal route as the operation of choice in treating a femoral hernia.

Zuckerkindl, after a series of anatomic dissections, recommended the inguinal operation for strangulated femoral hernia. In 1892 Ruggi described in detail the inguinal operation for femoral hernia, just about as it is used at the present time, in 1893 his monograph on this method appeared. Savini modified the Ruggi operation by using a suprapubic midline incision to obviate the danger of direct inguinal hernia which sometimes develops after operation by the inguinal route.

**Advantages for Nonstrangulated Femoral Hernia**—The inguinal operation can be performed as quickly as the femoral operation. An inguinal hernia, if present, can be treated at the same time, it is well tolerated by the aged patient because there is a minimum of shock. Free exposure of the sac is obtained by nicking the inguinal ligament or dividing it with a silk thread passed beneath it and then gently whipsawing, or by dividing the ligament in a step-ladder or staggered fashion in the presence of strangulation, to facilitate a firm repair. Never cut directly across the ligament as this error in technique accounts for most of the recurrences following the inguinal operation. The advantages of the inguinal operation far outweigh any slight advantage of the femoral operation even in reducible hernia. (Fig. 140.)

**Operation**—The operation for femoral hernia by the inguinal route is facilitated if the patient is placed in the Trendelenburg position. This aids in the reduction of the hernia and affords a clear view of the femoral opening.

**Skin Incision**—The incision is made over the inguinal canal about 1 inch (2.5 cm.) above the inguinal ligament and parallel to it. It is 3 to 5 inches (7.5 to 12.5 cm.) long and similar to the incision for inguinal hernia except that the upper end does not extend so high, and the lower end extends down over the pubic bone into the upper part of the scrotum or the labium majus, in the direction of the femoral ring or hernia.

**Incision of the Aponeurosis and Muscles**—The aponeurosis of the external oblique is separated in the direction of its fibers over the inguinal canal. The edges of the aponeurosis are retracted, exposing the conjoint tendon and transversalis muscle. These muscles are retracted upward along with the spermatic cord or round ligament. The inguinal ligament and the transversalis fascia are exposed when the lower flap of the aponeurosis is retracted downward. The floor of the inguinal canal, which consists of transversalis fascia, is carefully divided parallel to the deep epigastric vessels and to the inner side of them. This incision is directly over the neck of the femoral sac. The deep epigastric vessels are retracted outward. If they are abnormal in their course, they may



be divided between ligatures, however they should be preserved whenever possible, as their division may be a predisposing cause of postoperative direct hernia

With the transversalis fascia incised and the edges retracted the peritoneum is exposed and opened just above the neck of the sac (Fig 141)

*Reducing the Hernia*—In nonstrangulated hernia the contents are reduced by gentle traction. If they are adherent to the wall of the sac, the latter is often inverted as the contents are pulled back into the abdominal cavity. If the contents are not adherent to the sac it can usually be inverted in the following manner. A long narrow blade forceps is passed to the bottom of the sac the fundus grasped and as the forceps is withdrawn the sac is inverted.

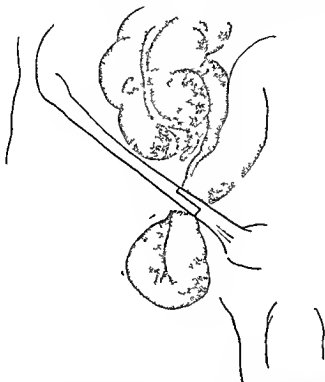


Fig. 140—Inguinal operation for strangulated hernia. When it is necessary to divide the inguinal ligament it should be done in a staggered or step-ladder manner. Never cut the ligament directly across a frequent cause of recurrence.

*Supplemental Femoral Incision*—If the sac cannot be reduced through the inguinal wound it is necessary to prolong the skin incision down over the hernia, retract the skin downward and dissect the sac free of adhesions. If the hernia is irreducible the sac should be opened by a femoral incision, the adhesions freed, diseased or redundant omentum ligated and excised and the hernia reduced.

*Strangulation*—If there is strangulation it is dealt with through the inguinal wound as it is much easier to handle it here than through the femoral incision and if resection and anastomosis are required they can also be done more expeditiously from the abdominal side.

*Inversion of the Sac in Irreducible Hernia*—After the sac has been opened and the contents have been dealt with the sac is inverted into the inguinal wound and treated from above. If the sac is large I cut away a portion of it to facilitate invagination. After it is inverted the peritoneum is freed for a distance of  $\frac{1}{2}$  inch (12.5 cm) beyond the femoral ring, transfixed by a needle threaded with a suture, ligated and excised. If the femoral opening is large a purse string suture of the neck of the sac is often preferable to simple ligation.

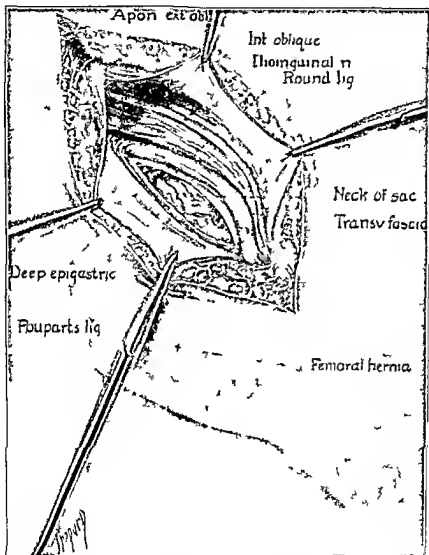


Fig 141—Inguinal operation for femoral hernia. Showing the exposure of the neck of the sac and its relation to the surrounding structures.

*Closure of the Femoral Ring*—Two to four heavy silk or cotton sutures are required to close the femoral ring. A small full curved needle threaded with the suture is passed through Cooper's ligament near the sheath of the iliac vein as the latter is pressed outward by the finger or a small retractor. A good plan is to pass the needle deep enough to include the periosteum and even

scrape the bone. Next the suture takes a good bite in the lower flap of transversalis fascia and the edge of the inguinal ligament. This suture is not tied until all are placed. Two or three additional sutures are inserted depending on the size of the opening; the innermost suture takes a bite in the lacunar ligament also. When the sutures are tied the femoral opening is closed by the approximation of Cooper's ligament to the inguinal ligament (Fig. 142) at the highest possible point as emphasized by Christopher.

Cooper's ligament which is a firm dense white band of fibrous tissue must always be thoroughly exposed before any suturing is attempted. The pectineal fascia which forms the posterior margin of the femoral canal is sometimes mistaken for Cooper's ligament.

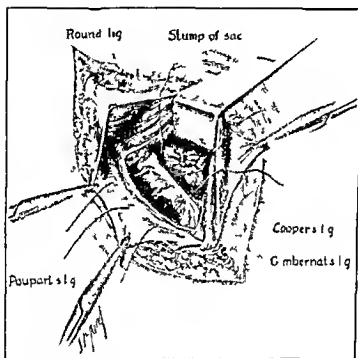


Fig. 142.—Inguinal operation for femoral hernia. Showing the ligation of the neck of the sac, Cooper's ligament, and the suturing of the femoral ring.

**Closure of the Muscle and Fascia Incision.**—The internal oblique transversalis muscle and the upper flap of transversalis fascia are sutured to Cooper's ligament and the inguinal ligament with interrupted sutures of silk or cotton.

**The Cord.**—The cord is usually not transplanted unless the internal inguinal ring is dilated or the musculature of the canal is weak or unless there is more than the usual danger of a direct hernia occurring through the inguinal incision.

**Skin Closure.**—The subcutaneous tissues and the skin are closed in the usual manner without drainage.

**Operation for Strangulated Femoral Hernia**—The operation for strangulated femoral hernia is more difficult than that for the nonstrangulated variety. Strangulated femoral hernia can be operated on by the femoral or the inguinal route. Partial strangulation or *nipping* of a portion of the lumen of the intestine (Richter's hernia) should always be thought of, as it is more frequent in the femoral variety of hernia than in any other. In this form of strangulation obstruction is not complete, and operation should not be undertaken even when the symptoms of strangulation are indefinite, as gangrene occurs early in partial strangulation, just as it does when strangulation is complete.

### Femoral Operation

The skin incision is begun  $\frac{1}{2}$  inch (1.25 cm) above the inguinal ligament and extended downward for a distance of 3 or 4 inches (7.5 to 10 cm) over the femoral canal, parallel to the femoral vessels. In small hernias the center of the incision is usually over the center of the tumor. Often it is a good plan to form

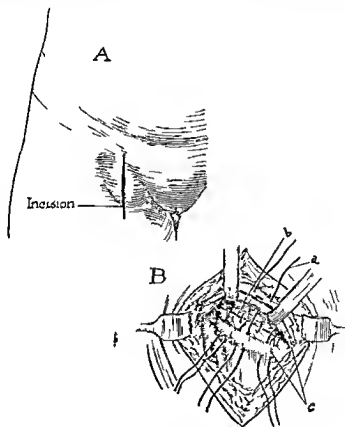


Fig. 143.—Femoral hernia operation. A. Incision over femoral hernia. B. Suturing the inguinal and Cooper's ligaments to the pectineus muscle and fascia.

a curved flap, with its convexity outward, so that the skin wound will be as far as possible from the external genitalia. If the incision does not extend sufficiently above the inguinal ligament, it will be difficult to expose the fascia lata and cruraiform fascia over the upper part of Scarpa's triangle (Fig. 143).

The internal (or long) saphenous vein passes upward along the inner side of the thigh and through the saphenous opening in the fascia lata about  $1\frac{1}{2}$  inches (3.75 cm) below the inguinal ligament. Care must be exercised not to wound this vein. The edges of the incision in the skin and subcutaneous tissues are retracted to expose the edge of the falseiform process of the fascia lata. If the hernia is reducible the femoral artery and vein are located and retracted out of the way and the pectineus muscle and fascia exposed. If the hernia is irreducible it may be impossible to locate any landmark except the femoral artery whose position is shown by its pulsation. A careful dissection will prevent mistaking the relaxed fascia propria the wall of the femoral sheath or the subperitoneal fat for adherent omentum.

*Freeing the Sac*—It is sometimes difficult to find the sac when it is deeply situated and covered by a thick layer of fat. The presence of the femoral vessels at the outer side of the neck of the sac must be borne in mind constantly. The sac should be freed by blunt dissection as high as the femoral ring. The sac is usually thin; if it is thick the possibility of a sliding hernia of the large intestine or the bladder should be thought of.

*Opening the Sac*—After the sac is freed it is opened at a thin clear point where there are no adhesions of the contents of the sac and if possible on the outer side to keep away from the bladder. Adherent omentum should be freed or divided between ligatures and the diseased portion excised. The treatment of sliding hernia of the large intestine or bladder is described elsewhere.

*Disposition of the Sac*—The sac freed of its contents is drawn well down at the femoral ring until the parietal peritoneum which is whiter denser and more fibrous than the sac comes into view. Exposure of the neck of the sac is facilitated by traction on the inner part of the ring—the lacunar ligament. The sac is pulled down transfixed ligated and excised. Sometimes it can be removed higher if a purse string suture of the parietal peritoneum is used instead of a ligature. Care must be taken to remove all the fatty lobules in or near the femoral ring so that the edges of the ring can be brought together after the sac is removed. (Fig 144)

*Closure of the Femoral Ring*—If the opening is small a purse string suture is all that is needed to close it. This method was first used by Marey in 1891 who employed a suture of absorbable tendon. Cushing and Coley (W. B.) popularized the purse string suture.

*Purse string Closure*—A full curved round pointed needle threaded with silk or cotton is passed through the inner portion of the inguinal ligament close to the femoral vein including if possible some of the fibers of the sheath of the vein. Coming out in the femoral canal the needle passes inward taking a good bite in the pectineus muscle and fascia Cooper's ligament and then through the inguinal ligament from within outward emerging near the original point of entrance. I have found that one suture is usually sufficient. Tying the suture approximates the inguinal ligament and the pectineal fascia and obliterates the femoral canal. If necessary a second or third purse string suture can be passed near the saphenous opening. (Fig 145)

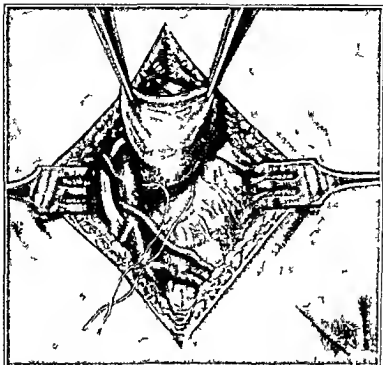


Fig 144—The sac is freed, drawn down and ligated at the femoral ring. Unless the sac is empty it must always be opened before being ligated.

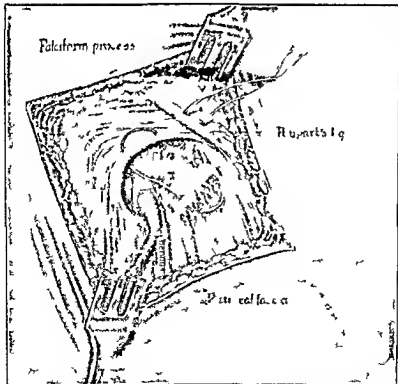


Fig 145—The sac has been ligated and excised and a purse string suture passed to close the femoral opening.

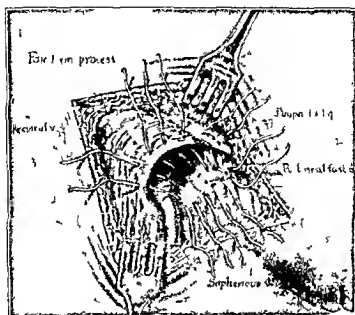


Fig. 146—Daessini's method of closing the femoral opening by two layers of interrupted sutures

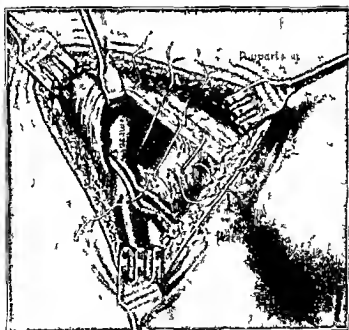


Fig. 147—Closure of the femoral opening by one layer of interrupted sutures that approximates Cooper's ligament, the pectenus muscle and fascia to the inguinal ligament

Bassini's method consisted of passing three or four interrupted sutures between the inguinal ligament and the pectineal fascia and two or three additional ones to approximate the falciiform process of the fascia lata and the pectineal fascia (Figs 146 and 147). Marchetti closed the femoral opening with three or four sutures passing through the lower edge of the aponeurosis of the external oblique, the internal oblique transversalis and Cooper's ligament, including the periosteum. Ottobruni, Costa and Manheim used a similar operation. Mendillo prefers the more complicated Bacon operation. Ochsner (A. J.) maintained that it is unnecessary to suture the femoral canal except when the opening is large and the femoral ring relaxed and widely dilated.

*Closure of the Subcutaneous Tissues and Skin*—The subcutaneous tissues are approximated by silk or cotton sutures and the skin is closed with interrupted subcuticular sutures without drainage.

Rees observed that the proximity of the femoral vein to the ring narrows the operative field and he advised changing the direction of the vein from its normal position of 15 degrees inward to 35 degrees and more. Outward abduction of the hip is secured by allowing the patient's flexed knee to hang over the side of the operating table. Additional displacement of the vein can be obtained by flexion and rotation of the hip. This latter maneuver is seldom necessary as it places the ring under tension.

Komora, in a review of the anatomy of the inguinal and femoral regions, concludes that freeing the fascia in the upper anterior thigh reduces the grip to be bridged in the closure of a defective anterior inguinal wall. The incision extends from the fossa ovalis at its inferiolateral extremity outward across the thigh and gives marked relaxation of the inguinal ligament.

### Operation for Strangulated Femoral Hernia

**Inguinal Route**—Most surgeons prefer the inguinal operation for strangulated femoral hernia. The operation is more difficult than for nonstrangulated hernia but the inguinal route gives a free exposure of the strangulation with little shock and is well tolerated by the elderly patient.

*Advantages of the Inguinal Operation for Strangulated Femoral Hernia*—The inguinal operation for strangulated femoral hernia has these advantages: it gives a good view of the sac and contents; the constriction is quickly located and easily divided; an abnormal obturator foramen is easily seen if present; there is more room to deal with the intestine and resection or anastomosis if necessary can be carried out easily and without traction on the loops; and it also permits inspection of the intestine at a distance from the ring beyond the point of constriction.

**Femoral Route**—The skin incision is made parallel to the inguinal ligament with its center over the most prominent part of the hernia. It is usually longer than is required for reducible hernia. The dissection is cautiously carried down through the subcutaneous tissues and fat to the sac which usually is dark red or bluish black in color. The sac should be freed up to the femoral ring before it is opened. In case it is impossible to isolate the sac it is necessary to divide its coverings very carefully either on a grooved director or by picking up



each layer separately and dividing it between tissue forceps. The sac should be opened with the greatest caution always bearing in mind the possibility of bladder wall or sliding hernia being inside of it. After the contents are examined the constricting point should be located. This is usually the sharp edge of the lacunar ligament at the femoral ring, less often the constriction is in the cribriform fascia. Blakeway maintained that strangulation was sometimes due entirely to a thickening of the neck of the sac.

When the constriction is found an attempt should be made to stretch it by digital dilatation the pressure always being directed inward. If this is not sufficient some surgeons pass a blunt forceps through the constricting ring and stretch it by opening the forceps; this procedure is dangerous and never to be recommended. The best plan is to retract the hernia at the neck outward, expose the fibrous margin of the constricting ring and carefully nick it under guidance of the eye on the inner side of the sac. I have found that a very superficial cut in the lacunar ligament is all that is necessary as this makes the further dilatation of the ring by the finger an easy matter. It is only very rarely necessary to nick or divide the inguinal ligament to relieve the strangulation. When the constriction is relieved diseased omentum is usually ligated and excised and the intestine if viable is returned to the abdomen.

If partial strangulation has resulted in a small gangrenous area it is sometimes possible to turn the necrotic portion in and close the healthy mucosa over it by two layers of Lembert or continuous sutures. If the gangrene is extensive it is necessary to do an intestinal resection. Litchgarry prefers a two-stage operation.

The disadvantage of the femoral route for dealing with strangulated hernia is that it is often difficult and sometimes impossible to do an intestinal resection without extending the incision upward through the inguinal ligament and entering the abdomen above the pubis. Sometimes in order to get sufficient room to treat the gangrenous intestine it is necessary to make an inguinal incision also, or in other words the combined operation is required.

*Lateral Rectus Incision for Strangulated Femoral Hernia*—When the femoral incision is employed and strangulated hernia is found time can often be saved if the abdomen is opened through a low lateral rectus incision. The intestine is cleansed, freed from adhesions in the sac, reduced into the abdominal cavity and drawn into the lateral rectus incision where it is surrounded by hot compresses and dealt with as its condition requires.

*Combined Abdominal and Femoral Incision*—Some surgeons prefer the combined femoral and abdominal incision in operating for femoral hernia especially if strangulation is suspected. A good technique for the combined operation is as follows: an incision 3 inches (7.5 cm) long is made with its first half over the inguinal canal parallel with the inguinal ligament. The second part curves down directly over the hernia; the aponeurosis of the external oblique is incised vertically beginning at the inguinal ligament and extending downward along the border of the femoral vein for a distance of about 1 inch (2.5 cm).

The inguinal ligament is separated in the direction of its fibers, the sac is exposed and opened, the contents are reduced and dealt with in the usual manner, and the sac is ligated as high as possible. The divided edge of the inguinal ligament and the conjoined tendon and the upper edge of the flap of the inguinal ligament are sutured to it.

In dealing with strangulated femoral hernia through the combined inguinal and femoral incision, any omentum in the sac should always be ligated and excised before reduction is attempted. Gentle traction is made first on one and then on another portion of the strangulated loop, combined with light taxis on the tumor. It is usually a simple matter to reduce the hernia by this maneuver, however, if it is not immediately successful, it is necessary to enlarge the femoral ring by nicking the lacunar ligament.

Tuffier called attention to the fact that the operation is facilitated if the omentum is divided as high as possible as soon as the sac is opened, before any attempt is made to reduce the intestine.

Ware suggested that when it is difficult to divide the constriction at the lacunar ligament it is easily accomplished by passing a fine silk thread through the femoral ring on a blunt needle and then gently whipsawing the thread. The thread can then be used as a retractor to aid in reducing the hernia.

*Perforation or Abscess in the Femoral Sac*—When femoral hernia is operated on by the inguinal route and the bowel is found perforated or when an abscess has formed in the sac, no attempt should be made to remove the sac, but a femoral incision should be made to drain the wound. Schrager stitched the sac to the skin and used it as a drainage tube.

Roux suggests that, in strangulated hernia that is difficult to reduce, the patient be placed in the Trendelenburg position and the incision be enlarged upward cutting the femoral ring and opening into the abdominal cavity through the incision, then reducing the strangulation by pulling it upward. This gives easy access to the strangulated intestine and resection can be done without difficulty. When the patient is desperately ill and it is evident that gangrene has developed, Mulviny advises a three stage operation.

*Preoperative and Postoperative Treatment of Strangulated Hernia*—Before operation, fluids should be administered intravenously to restore the body level that has been lowered by nausea and vomiting. Blood transfusion is usually advisable to replace blood cells and minerals. Distention of the abdomen should be reduced by the use of the Wangenstein suction tube in addition to the usual low rectal tube. The bladder should be emptied by a catheter just before operation.

*Anesthesia*—Spinal anesthesia is suitable for the good risk patient. It is contraindicated when the systolic blood pressure is below 120 mm. When the patient is gravely ill, advanced in age, or otherwise a poor risk, local anesthesia should be used.

The postoperative treatment of strangulated hernia should include the breathing of 95 per cent oxygen to help displace by diffusion the nitrogen con-

tained in the distended or strangulated bowel. Blood transfusion and physiological salt solution should be used to replace loss of blood cells and minerals by vomiting or otherwise.

An impaired circulation or damaged myocardium is benefited by a 50 per cent dextrose or glucose solution, giving 100 to 200 cc by venoclysis twice daily, before and after operation. The addition of some form of chloride is also helpful. Penicillin, 20,000 units hypodermically every three hours one day before operation and two days postoperatively is advisable to combat infection. If administered orally, the dose units should be tripled.

### Accidents During Operations for Femoral Hernia —

*Injury to the Bladder* —The sac should always be examined very carefully. Bladder involvement should be suspected when the sac is thick when it is covered by a quantity of lemon colored peritoneal fat or when there are numerous blood vessels on its surface. When the bladder is in the sac wall, it is nearly always on the inner side, and for this reason the sac should be opened at a thin white point on the outer side. (See chapter on hernia of the bladder.)

*Sliding Hernia* —When there is a sliding hernia of the large intestine, care must be taken not to open the intestine by mistake for the sac.

*Injury to the Blood Vessels* —The surgeon must be on the lookout constantly for the deep epigastric artery and vein, the femoral vein, and an aberrant obturator artery. If the deep sutures are placed too close to the femoral vein the pressure may result in a transient edema of the lower extremity, or rarely a thrombosis.

Piotrowski reported 108 operations for femoral hernia by the Kummer method, with the following accidents: The femoral vein was punctured once, the saphenous vein was punctured once and the bladder was wounded once.

In a case reported by Black the femoral vein was injured during an operation for strangulated femoral hernia. The hernia had been strangulated for forty hours and there was considerable edema and discoloration of the tissues making it difficult to recognize the vein. The lateral ligature was applied to the cut in the vein and an uninterrupted recovery followed. Four weeks after the operation the entire lower extremity became swollen and edematous. This condition finally disappeared under treatment.

Willis related the experience of a physician who incised a saphenous varix by mistake for a femoral hernial sac. He was so surprised that he fainted and an assisting physician checked the hemorrhage and probably saved the patient's life.

Gibbon reported an instance in which a surgeon punctured the femoral artery while suturing the femoral ring. He secured the cut with a hemostat and applied a lateral ligature. No complications followed the accident. The hernia recurred after a short time.

Kathan reported an accident that occurred in the practice of another surgeon. The femoral artery was punctured with the needle in closing the femoral opening. The artery was ligated to check the hemorrhage and when collateral circulation failed to establish itself, an amputation of the thigh was

necessary. Kathan reported another instance in which marked swelling of the leg and thigh had persisted for nine years following an operation for femoral hernia. In a third case a septic exstity, which was thought to be due to catheterization, developed a week after operation. It disappeared in two weeks following the voiding per urethram of a chromic catgut ligature, which evidently had been used to tie off a portion of the bladder by mistake for the sac, or else the bladder was perforated when the wound was closed.

**Early Rising After Hernia Operations**—Rest in bed after hernia operations has been a subject of considerable controversy among surgeons. I believe it is best to let the patient sit up in bed two or three times for a few minutes and later let him stand on the floor a few minutes on the first day. Have him out on the floor for a few minutes the second day, and gradually increase the time out of bed each succeeding day. In less than a week all weakness disappears and he can get around alone.

Early rising has many advantages. It practically eliminates postoperative pulmonary complications, other complications are usually nonexistent, the patient's vital capacity is not lowered as it is when he is kept recumbent, there is less tendency to cough, there is less postoperative temperature, wound healing is improved, and there are no more recurrences than following a week or two in the recumbent posture.

Powers, Schafer and Dragstedt, Coley (B. L.), Cutler, Fallis, and many others have long advocated early rising after hernia operations.

The only contraindication to early rising is the patient's being very obese. He should be kept recumbent for five to seven days.

Burch and Fisher reported 1,919 hernia operations. All of the patients were up the first day with no ill effects.

**Effect of Sutures on Temperature and Pain**—Silk and cotton sutures are much less irritating to the tissues and cause less systemic reaction and fever than catgut sutures. This is strikingly demonstrated by the studies of Zollinger and Flynn who compared a series of cases in which catgut had been used to a group in which the wound had been sutured with cotton. The advantages with cotton stitches was strikingly demonstrated.

1. Less postoperative induration occurred and it resolved more rapidly with cotton sutures.

2. Patients whose hernias were repaired with catgut usually required narcotics to control pain, while those with cotton repaired wounds were able to rest with milder sedatives.

3. Postoperative temperatures ranged higher in the patients who had catgut suture of the wounds.

**Allergy to Catgut Suture Material**—Many patients are allergic to catgut sutures, and extensive experimental and clinical research has established the fact that in most of the cases of unexplained delayed wound healing, the complication can be ascribed to the patient's allergy to catgut. Henry has done much work on this phase of allergy.

**Recurrence of Femoral Hernia**—While the inguinal route is the operation of choice it gives a higher recurrence rate for those not familiar with its technique. I am convinced that a majority of the cases of recurrence following operation by the femoral route are due to the failure of the operator to close the femoral ring. He passes the deep sutures through the pectineal fascia which forms the posterior margin of the femoral canal mistaking it for Cooper's ligament.

Femoral hernias are usually slower in recurring after operation than other varieties, seldom recurring before the second year after operation. Operations for strangulated femoral hernias recur earlier and more frequently than do operations for nonstrangulated hernias. Gutierrez stated that with the inguinal operation primary femoral hernia had a recurrence rate of 7 per cent while recurrent femoral hernia had a rate of 17 per cent. Moore believed the inguinal recurrence rate to be about 10 per cent. McClure and Falls however found an inguinal recurrence rate of 7.4 per cent, while it was 9.7 per cent with the femoral operation. Ferguson stated recurrence followed the inguinal operation in 9.2 per cent of the cases and in 6.3 per cent after the femoral operation. Coley (B. L.) observed that in 211 operations for femoral hernia at the Hospital for Special Surgery, 13 (6 per cent) recurred and there were 3 deaths (1.5 per cent). Shelley collected 226 femoral hernia operations including strangulated hernia in which the recurrence rate was 15.4 per cent. Dean found a recurrence rate of 12 per cent in primary femoral hernia and 23 per cent following operation for strangulated hernia. Waleley in 1940 stated that 2 per cent recurrence could be expected in uncomplicated operations by the femoral route and 9 per cent recurrence with the inguinal operation. For recurrent femoral hernia the rate is very high as the appended table shows.

FEMORAL TYPE OPERATION	CASES	TRACED	RECURRENT	PER CENT
Primary	535	436	20	4.6
Recurrent	75	51	31	60.8

Heschke examined 170 patients several years after operation by the femoral route in which the opening was closed by a mattress suture. There had been only 3.5 per cent of recurrences. Bileh stated that a careful follow up of patients operated on by the inguinal or femoral methods will show a recurrence rate of 10 to 20 per cent.

Statistics I have collected from a number of clinics give the following results:

METHOD	NO CASES	NO RECURRENCES	PER CENT RECURRENCE
Femoral operation with closure of ring	409	19	4.65
Suturing Cooper's to the inguinal ligament	6	33	4.98
Muscle plastic operation (Salzer)	18	18	9.89
Operation by the inguinal route	206	10	4.85

**Suture Material as a Cause of Recurrent Hernia**—The general adoption of silk and cotton sutures, in place of catgut will reduce the recurrence rate for femoral hernia operations just as it has done for inguinal hernia repair. Catgut is indicated only when gangrene of the intestine accompanies strangulation. Ochsner (Alton) observed that catgut rapidly loses its tensile strength while cotton holds for weeks.

Maier in 1941 published the results following the use of silk sutures in 777 operations for hernia with 552 or 71 per cent traced one year or more. Infections decreased as experience was gained in the use of silk.

TYPE OF HERNIA	NO CASES	NO RECURRED	PER CENT
Primary indirect inguinal hernia	334	0	6.3
Primary direct inguinal hernia	118	17	12.7
Primary ventral hernia	2	1	45
Primary femoral hernia	20	3	15.0
Recurrent femoral hernia	1	0	0.0
Recurrent inguinal hernia	40	15	37.5
Recurrent ventral hernia	7	1	14.5

**Postoperative Complications**—The postoperative complications following femoral hernia operations are much the same as occur after inguinal hernia repair and call for the same treatment. Shelley studied a group of 226 femoral hernias postoperative complications after primary femoral operations were 15.6 per cent after recurrent femoral hernia operations 18.8 per cent.

Perforation of the intestine is rare. However it may occur even when the intestine is viable at the time of operation. In case the hernia has been reduced by taxis it is very important to watch the patient carefully for the first twenty-four hours for symptoms of gangrene or perforation.

**Local Anesthesia for Femoral Hernia Operations**—I believe local anesthesia should be employed for all femoral hernia operations except in young children. It adds to the safety and comfort of the young and robust and when the patient is handicapped by old age shock hemorrhage pulmonary nephritic or cardiac lesions or when the hernia is strangulated the local method is a necessity.

**Operation for Femoral Hernia and Varicose Veins**—When there are varicose veins in the femoral region they should be excised at operation for femoral hernia if the femoral route is used. A femoral hernia pressing on the internal saphenous vein is often the cause of varicose veins in subjects with large femoral hernias.

**Combined Operation for Femoral Hernia and Appendicitis Through the Inguinal Incision**—Some surgeons advise removing the appendix when it is nongangrenous but diseased through the inguinal incision for femoral hernia. I believe, however, that the appendix should always be removed through a separate incision when appendicitis complicates either femoral or inguinal hernia.

**Mortality Rate Following Operation for Nonstrangulated Femoral Hernia**—In 700 operations for nonstrangulated femoral hernia including my own and those that I collected from the literature there were 9 deaths (1.28 per cent).

**Mortality Rate in Strangulated Femoral Hernia**—Strangulated femoral hernia carries a high mortality rate when the diagnosis is not made promptly or when operation is delayed unduly or refused by the patient or his family.

I have noted a mortality rate of 18 per cent when operation for strangulated hernia was early, and 50 per cent when treatment was delayed, usually due to failure to make a diagnosis. *Dunphy, in 1945, studied the mortality rate in relation to vascular change in the intestine at the Peter Bent Brigham hospital*

GROUP	NUMBER OF OPERATIONS	DEATHS	MORTALITY (PER CENT)
1 Uncomplicated by obstruction or gangrene of the intestine	100	0	0
2 Complicated by intestinal obstruction, bowel viable	31	0	0
3 Complicated by intestinal obstruction and gangrene	20	10	50

Mortality rate in strangulated femoral hernia in relation to age of the patients and vascular change in the bowel was as follows

AGE OF PATIENT	CONDITION	NO OF CASES	DEATHS	PER CENT
40 70	Intestinal obstruction and gangrene	11	4	36.3
70 80	Intestinal obstruction and gangrene	9	6	66.7
40 70	Intestinal obstruction, bowel viable	21	0	0
70 90	Intestinal obstruction, bowel viable	10	0	0

*Dean reported a mortality rate of 83 per cent in strangulated femoral hernia, death from peritonitis, 50 per cent, death from wound infection, 33 per cent*

**Mortality Rate in Relation to Duration of Symptoms**—It cannot be too strongly emphasized that if we are to reduce the mortality rate in strangulated hernia, diagnosis must be made earlier and operation undertaken more promptly. *McNealy and Lichtenstein, in 1942, found the mortality rate and duration of symptoms were as follows*

DURATION OF ACUTE SYMPTOMS	NO OF CASES	DEATHS	PER CENT
12 hours	15	1	6.6
24 hours	37	6	16.2
2 days	27	7	25.9
3 days	27	5	18.5
4 days	14	4	28.5
5 days	20	4	20
6 days	8	2	25
1 week plus	25	9	36

*Jens, in 1943, reviewed 100 cases of strangulated femoral hernia*

GROUP	CASES	DEATHS	MORTALITY (PER CENT)
Nongangrenous intestine and omentum	66	4	6.0
Gangrenous intestine Resection	12	8	66.6
Gangrenous Minor procedure	8	2	25.0

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## CHAPTER XXI

### UMBILICAL HERNIA

**Definition**—Umbilical hernia is a protrusion of abdominal viscera through the umbilical ring.

Umbilical hernia may occur through an orifice which has failed to close in embryonic life or through the umbilicus which closed at birth and pathologically opened in infancy or adult life. These hernias may be congenital or acquired and are most conveniently considered by dividing them into three classes: congenital hernia of the cord, umbilical hernia in infants, and umbilical hernia in adults. The umbilical variety constitute 2 per cent of all hernias.

#### Congenital Hernia of the Cord

**Synonyms**—Congenital umbilical hernia; amniotic hernia; omphalocele; congenitalis hernia funiculi umbilicalis; ectopia viscerum.

Strictly speaking this condition is not a hernia because as pointed out by Malgaigne the viscera have never entered the abdominal cavity. As early as 1691 Ruyseh called attention to the fact that an umbilicus is not developed in these cases. The condition is really an eventration that is due to maldevelopment of the embryo and is considered under umbilical hernia only because from a surgical standpoint it is customary to do so. Thunig in 1936 discussed at length hernia into the umbilical cord. Jarecho in 1937 published a comprehensive historical review of the subject. Santos in 1939 reported two cases of congenital exomphalos and its surgical treatment and Morrison and Neville in 1943 found a Meckel's diverticulum in an omphalocele and operated successfully when the infant was six days minutes old.

#### Umbilical Hernia in Infants

**Synonyms**—Infantile umbilical hernia; starting of the navel.

#### Umbilical Hernia in Adults

**Synonyms**—Hernia of the umbilical ring; hernia umbilicalis.

#### Historical

The mechanical treatment of umbilical hernia dates back to very early times. Celsus the famous Roman physician of the first century A.D. used compresses and bandages very much as we do today. He wrote: "And if the intestine comes down in a young child, a bandage must be made trial of before the knife, for this purpose a roller is used to which in one part a bolster is sewed made of cloths which is applied under the intestine to repel it and then the rest of the roller is bound tight about him, by means of which, the intestine is often forced in and the coats are agglutinated together."

On account of the favorable location of umbilical hernia, it was more frequently subjected to operation in ancient times than were the other varieties. Celsus used the elastic ligature in the treatment of umbilical hernia. This method was widely used and kept alive through the centuries by the writings of Paulus Aegineta, the celebrated Greek surgeon, who practiced in Alexandria during the seventh century, Avicenna, who lived in the eleventh century, the most famous of the Arabian physicians, Guy de Chauliac, the eminent French surgeon, who wrote a treatise on surgery in the fourteenth century, Paré, "the father of French surgery," who lived in the sixteenth century, de Garengot, Saviard, and Petit. The ancient forms of treatment were gradually displaced by other methods and were revived only with the advent of the antiseptic period of surgery.

The operative treatment for strangulated umbilical hernia employed by the early surgeons was limited to the incision of the gangrenous mass. The mortality rate was high, due to peritonitis and the development of fecal fistula. Hey, in 1803, described 3 cases, Cooper, in 1807, wrote on umbilical hernia, and Searpa, in 1809, dealt with the anatomy and found a lobe of the liver in the hernial sac.

The radical operation for nonstrangulated umbilical hernia is of recent origin. Bérard, in 1841, was the first to operate for the congenital variety. MacDonald, in 1890, was able to collect from the literature 19 operations for this condition, with 17 cures and 2 deaths. Storer, in 1864, was probably the first in the United States deliberately to undertake to cure a nonstrangulated umbilical hernia in an adult, by radical operation. Primary union resulted and the patient was cured.

The modern operation dates from the longitudinal overlapping of layers of fascia by Lucas Champroniere, in 1881. Mayo, in 1894, was the first to propose a transverse overlapping of fascia, and over the years this method still gives the lowest percentage of recurrences. Samy, in 1935, wrote on the operative treatment of umbilical hernia, Gutierrez, in 1936, described a special operative technique, Osten, in 1937, found a lobe of the liver in a strangulated hernia (Searpa reported the first case in 1809). Parsons in 1940, noted the frequency of the failure of the closure of the umbilicus in soldiers, Borias in 1940, discussed the difficulties of operation in large hernia, Mahorner in 1940, published an excellent review on umbilical hernia and described his operation of longitudinal overlapping of fascia, O'Leary and Clymer, in 1941, also described a good method for lateral overlapping of fascia. Jones, in 1941, observed a greater frequency of umbilical hernia in Negro infants, White, in 1943, wrote on the high mortality rate following operation for strangulated umbilical hernia in elderly patients, and Bennett Jones, in 1944, reported excellent results with the injection treatment of small umbilical hernia in infants, in the majority requiring only one injection to effect a cure.

### Etiology

**Congenital Umbilical Hernia**—*The cause of embryonic hernia is an error in development. The viscera fail to regress into the abdominal cavity, and*

the visceral plates do not close to form the umbilicus, as they normally should at the third month of intrauterine life. A majority of the congenital hernias are of the embryonic type. Congenital hernias of the fetal period develop after the obliteration of the umbilical orifice which takes place at the end of the third month of intrauterine life.

**Umbilical Hernia in Infants**—The exciting causes of infantile umbilical hernia are any sudden increase in intraabdominal pressure such as a fall, whooping cough, flatulence, phimosis and constipation. A large umbilical cord may act as a predisposing cause of delayed cicatrization of the umbilicus.

**Umbilical Hernia in Adults**—After the age of three umbilical hernia is rare until the age of twenty five when it rapidly increases in frequency until forty years is reached. It decreases only slightly up to fifty five years when it again becomes rare. Obesity and pregnancy are the principal causes.

**Obesity**—Obesity increases intraabdominal tension as the result of the deposit of fat in the omentum, mesenteries and anterior abdominal wall. The weight of this mass puts a strain on the abdominal muscles which relax, atrophy and separate at the weakest point—the umbilicus.

**Pregnancy**—The distention of the abdomen during pregnancy weakens the anterior abdominal muscles. The speedily after delivery, with the tendency to obesity that follows repeated pregnancies, explains why a majority of these hernias are found in women.

**Other Causes**—Violent exercise, falls or any form of overexertion may produce umbilical hernia. Rapid emaciation of an obese individual by diet or disease and suppuration in the region of the umbilicus, may act as predisposing causes. Umbilical hernia may attain large proportions unless properly treated in the early stages. In nulliparae the most frequent predisposing causes are fibroids of the uterus, cysts, ascites and tumors of the ovaries.

### Anatomy

**Surface Anatomy**—The variations in the contour of the abdomen in the umbilical region are marked depending on the age, sex, occupation and muscular development of the individual. Obesity plays an important role especially in the female.

In the male and in children the abdomen is wider above the umbilicus while in the adult female the widest portion is below (Fig. 148). The umbilicus marks the most prominent part of the abdomen. It is usually below the midpoint between the infrasternal notch and the symphysis pubis and a little below the highest part of the iliac crest and opposite the middle of the body of the fourth lumbar vertebra. When the abdominal muscles have lost their firmness and tone as a result of age, disease, repeated pregnancies or obesity the umbilical region becomes prominent and more or less pendulous so that the umbilicus loses its normal contour and often lies considerably below the normal level. In the child it is lower relatively than in the adult because of the undeveloped state of the pelvis.

**Congenital Umbilical Hernia.**—In congenital umbilical hernia the anterior abdominal wall fails to close in the region of the navel, owing to a defect or error in development during intrauterine life. These large congenital hernias are frequently covered by a thin transparent membrane that is continuous with the parietal peritoneum. In the smaller hernias the only



Fig. 149.—The normal umbilicus. Showing the linea alba and the recti muscles.

contents may be a knuckle of intestine or a Meckel's diverticulum, which protrudes into the cord and separates the structures (*hernia at the root of the cord*); in these cases the intestine should be returned into the abdomen before the cord is tied.

**Congenital Umbilical Hernia and Other Malformations.**—Other malformations may exist along with congenital hernia. Among the defects that

have been observed are atresia of the large intestine, imperforate anus and ureter, exstrophy of the bladder, meningocele, spina bifida, sacrococcygeal tumor, club foot, polydactylism, harelip, cleft palate, hypospadias, and epispadias

Of 16 cases of congenital umbilical hernia collected from the literature by Hertzfeld, 12 were found with one malformation, or more than one, cleft palate was found 4 times, spina bifida 4 times, meningocele once, exstrophy of the bladder 5 times and vesical fistula 3 times

The size of the hernia depends on the amount of skin lacking, the condition of the surrounding muscles, and the degree of intraabdominal pressure. The hernia is covered by amnion and a thin layer of peritoneum, between these, there is usually a layer of Wharton's jelly. The sac is thin and translucent and the organs can be plainly seen through it. It is freely movable over the viscera, unless inflammation has occurred and adhesions have formed. The large hernias are almost always irreducible, as the abdominal cavity has adapted itself to its customary contents.

### Embryology

**Parts Passing Through the Umbilicus in Fetal Life**—The structures passing through the umbilicus during fetal life are the urachus, umbilical arteries, umbilical vein, some of the fetal membranes, and a portion of the digestive tract.

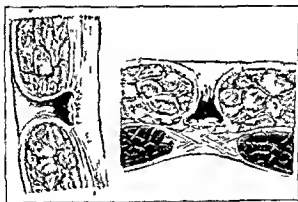


Fig. 149.—The umbilicus. Showing the firm cicatrix that forms after the normal closure of the opening. Medial and transverse sections.

**Normal Closure of the Umbilicus**—The umbilical ring closes after birth because it has no further function to perform. The contents of the arteries and vein clot, and the whole mass is converted into connective tissue. The umbilical ring contracts, and the result is a firm scar at the site of the umbilicus with fibers decussating above it, one set across the median line and two sets of circular fibers interlacing upon the lateral aspects of the umbilicus. A few days later after the cord is tied, the elastic fibers of the umbilical ring contract and the stump separates on a level with the abdominal wall. The urachus, umbilical vein, and two allantoic or hypogastric arteries are cut off.

by the contracting umbilical ring. The slender connective cords representing these obliterated vessels converge toward the umbilical cicatrix, the vein from above and the arteries from below. As the umbilical cicatrix becomes firmer, and the growth of the abdomen continues, these cords become tense and the umbilicus is drawn inward more markedly at the lower portion where the stronger cords of the urachus and umbilical arteries are firmly attached to the ring. The cord representing the umbilical vein is small and loosely attached to the upper edge of the ring which feels sharp and can be felt more distinctly than the lower margin. After the age of two years the umbilical cicatrix has become sufficiently firm to prevent the development of hernia in this region as long as the muscles maintain their normal size and do not become weakened by fatty deposits (Fig. 149).

**Umbilical Hernia in Infants**—Infantile umbilical hernia usually develops during the first six months of life. Following a strain that increases intra-abdominal tension, a knuckle of intestine forces an opening between the vein and the upper margin of the ring where the umbilical scar tissue is the weakest.

These hernias are almost always small and with a properly fitting abdominal binder they are often cured spontaneously because of the normal contraction of the umbilical and periumbilical scar tissue. After the age of three years umbilical hernia is rare until early adult life.

### Size and Shape of the Hernia

**Congenital Umbilical Hernia**—The linea alba closes first from the pubes to the umbilicus and later from the ensiform cartilage downward. For this reason in the majority of cases the opening is found to extend from the umbilicus halfway to the ensiform cartilage. When the embryonic development is arrested early the defect in the abdominal wall may be large in stances extending from the manubrium sterni to the symphysis pubis.

The size of the hernia may vary from a slight protrusion no larger than the finger tip to a tumor the size of a fetal head. Most of these hernias are small, seldom being more than an inch (2.5 cm.) in diameter. They are pedunculated tumors which protrude through a dilated umbilical ring and they extend as a cylindrical mass for an inch or two (2.5 to 5 cm.) into the cord. The margin between the skin and the tumor is well defined and they should never be mistaken for the cord alone. A number of cases are on record in which a portion of intestine or a Meckel's diverticulum has been tied off with the cord. The large hernias are oval or pear shaped and the skin reaches only to the margin of the opening. The hernial contents are covered by a translucent membrane whose lower portion is connected with the umbilical cord (Figs. 150 and 151).

**Umbilical Hernia in Infants**.—Infantile hernias may vary in size from the *umbilical button* which is no larger than the tip of the finger to a tumor as large as an adult's head. Small hernias are usually spherical in shape becoming conical as they increase in size. The sac is almost always adherent at the fundus or at the cicatrix.



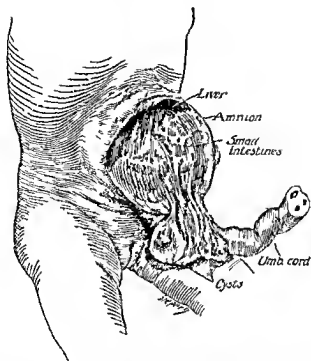


Fig 150—Congenital hernia of the umbilical cord. This condition is really an eventration due to maldevelopment of the embryo as the viscera have never entered the abdominal cavity.

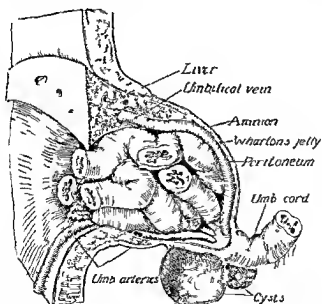


Fig 151—Congenital hernia of the umbilical cord. Mesial section showing the sac contents, the separation of the vessels, and two small cysts on the cord.

**Umbilical Hernia in Adults**—Small umbilical hernias in obese patients may not be noticeable and can be palpated only with difficulty. The hernia, as it enlarges, extends downward, in some instances it has been known to reach below the knees and to render the patient an invalid. The large hernias, which burrow outward and downward between the skin and the muscles, are held by the firm fascia at the ring. Adhesion of intestine to the sac is rare, but omental adhesions form early between the contents and to the sac wall itself, especially at the fundus. The hernia becomes irreducible early, and presents an irregular appearance owing to the intrasaccular adhesions. Strangulation may be due to the protrusion of a knuckle of intestine through an opening in the omentum, or in rare instances to constriction by the umbilical vein. The skin overlying the hernia is very thin and almost always presents one or more scars, the result of healed ulcerations.

**Openings in the Sac**—While there is usually only one opening between the abdominal cavity and the sac, in very large hernias there may be two or more. Almost always these are false openings leading into different loculi in the sac, and they are due to adhesions of the omentum, however there may be a second opening through the linea alba near the umbilical ring and usually above it. Sometimes the openings in the linea alba lead into separate sacs lying side by side. The opening in the fascia is usually not over one to 3 inches (2.5 to 7.5 cm). Several years ago, I operated on a patient who weighed 400 pounds who had a hernia that reached below the pubes, while the circular opening in the fascia through which the whole of the transverse colon and huge masses of omentum protruded measured only 1 inch (2.5 cm) in diameter.

### Contents of the Sac

**Congenital Umbilical Hernia**—There are two types of congenital umbilical hernia, embryonic and fetal.

**1 Embryonic Hernia**—The contents of small embryonic hernias ordinarily consist of one loop or more of small intestine. Sometimes the cecum is found in the sac, and occasionally a part of the liver. In 47 cases collected from the literature by Macready, the intestine was found alone in the sac 28 times, the intestine and liver 9 times and the liver alone, 10 times.

The very large hernias or true eventrations, may contain part of the abdominal viscera, or all of it, even the pancreas, and also the lungs, heart, and pelvic organs. Rarely, the hernia may consist of a urinary diverticulum or a partial exstrophy of the bladder, which may have a fistulous opening lined with mucous membrane.

**2 Fetal Hernia**—The fetal hernias are never so large as the embryonic variety, and almost always consist of small intestine and omentum. The parietal peritoneum protrudes in the region of the umbilical cord, and displaces the vein upward, separating the two arteries which are below. (Fig 152)

**Umbilical Hernia in Infants**—In small infantile hernias the sac is empty, except when a knuckle of intestine is forced into it as the child cries or strains. Larger infantile hernias may contain one or more loops of small intestine and

rarely a portion of transverse colon. If the hernia is neglected and allowed to increase in size it may have the same contents as the adult variety.

**Umbilical Hernia in Adults**—Umbilical hernia in adults always contains omentum, usually a loop of transverse colon and sometimes small intestine. The stomach, liver, gallbladder, spleen, pancreas, cecum, appendix and sigmoid are rarely found. The omentum always lies in front and may form a complete lining of the peritoneal sac. In a woman aged fifty-eight years, Osten found a lobe of the liver the sole content of the sac in a strangulated umbilical hernia.

**Hernia of Meckel's Diverticulum**—In 27 cases of umbilical hernia of Meckel's diverticulum that I collected from the literature, only 1 was in an adult. Nearly all the patients were newborn infants.

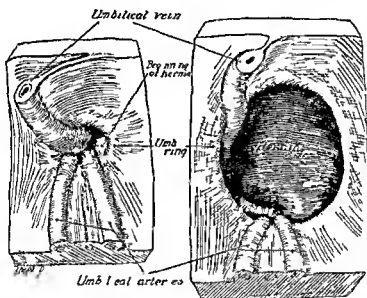


Fig. 157.—Congenital hernia of the umbilical cord. The peritoneal aspect. The small hernias are of the fetal type and contain small intestine and omentum. The umbilical vein is displaced upward, separating the two arteries which are below.

**The Uterus**—The uterus is sometimes found in the hernial sac. Instances are on record in which the pregnant uterus, as it enlarges, enters the umbilical hernial sac, displacing the other viscera into the abdomen. It is usually possible to force the uterus back into the abdominal cavity even at term, however, if it is irreducible, delivery by hysterotomy is necessary. (See chapter on hernia of the ovary tube and uterus.)

In rare instances fatty tumors are found in the sac. They are usually attached to the large intestine and are most commonly hypertrophied appendices epiploicæ. This was true in 7 of the 15 cases collected from the literature by Rubin.

#### Coverings of the Hernia

**Congenital Umbilical Hernia of the Cord**—In the congenital umbilical variety the coverings of the hernia are amnion and parietal peritoneum.

**Umbilical Hernia in Infants**—In the infantile umbilical variety the coverings are the peritoneum transversalis fascia superficial fascia the fibrous tissue of the umbilical scar the linea alba and the skin

**Umbilical Hernia in Adults**—In adults the coverings of the hernia are the peritoneum which forms the sac the transversalis fascia and the skin. The coverings are usually very thin especially over the fundus

### Frequency of the Varieties of Umbilical Hernia

**Congenital Umbilical Hernia of the Cord**—Congenital umbilical hernia is very rare occurring about once in every 10 000 births. Of 69 cases collected from the literature by Busel in 43 were in males and 26 in females. In 151 691 newly born infants at the New York Lying In Hospital 152 had umbilical hernia at birth

**Umbilical Hernia in Infants**—Infantile umbilical hernia is very common during the first year of life. It is less frequent in the second year and seldom occurs after the third year. It appears in both sexes with nearly equal frequency being perhaps slightly more frequent in boys in whom it is often associated with inguinal hernia. About 50 per cent of the umbilical hernias in males appear in the first year and in females only 20 per cent occur during this period

Jones states that 80 per cent of the infants that come under his observation have umbilical hernia and that it is two to four times more frequent in Negro infants than in white infants. He believes the higher incidence in Negro infants is probably due to heredity

**Umbilical Hernia in Adults**—Umbilical hernia in adults begins to appear about the age of twenty years and after this year it increases slowly in males and rapidly in females owing to the beginning of the child bearing period. Over 75 per cent of all cases occur in females. O'Leary and Clymer observed a ratio of 25 women to 8 men with umbilical hernia. They noted that inguinal hernia was a complication in 30 per cent of the patients

**Recurrence After Apparent Spontaneous Cure**—While a large percentage of infants are cured of umbilical hernia by truss or bandage treatment there is a small number in whom there is no response to these measures. Others may be apparently cured but if carefully examined the navel will be found relaxed the ring enlarged and a small peritoneal fossa still present. These hernias are liable to recur later in life following an exciting cause which increases intraabdominal pressure such as trauma obesity pregnancy or abdominal tumors

### Symptoms and Diagnosis

**Congenital Umbilical Hernia of the Cord**—The symptoms of congenital umbilical hernia are principally objective. There is a tumor in the umbilical region which is so apparent that it can scarcely be mistaken for any other condition. As intestine is usually in the sac the tumor is tympanitic on percussion and there is a gurgling sound on manipulation. The small hernias can be reduced but they immediately reappear. If the liver is in the hernia a brown colored mass can be seen through the sac and the tumor is only par-

tially reducible. The stomach in the hernia gives rise to digestive disorders, such as colic and vomiting immediately after nursing. Hernias consisting of bladder diverticulum present a fluctuating transparent tumor in the hypogastric region, which is frequently associated with imperforate urethra and retention of urine in the bladder and urachus.

**Complications.**—The sacs of large hernias may rupture in the uterus or during delivery. On account of the eventration or other defects, infants with congenital hernia of the cord usually do not live. The thin sac over the viscera quickly dries and is easily ruptured, or inflammation develops with ulceration at one point, or more, on the membrane. With the bursting of the sac, fatal peritonitis quickly follows. Instances of spontaneous recovery are very rare.

A fecal fistula may result if a part of the intestine or a Meckel's diverticulum is caught in the ligature of the cord. Instances of fatal peritonitis following this accident are also on record. Following straining or crying, a loop of intestine may protrude through the fistulous opening and become strangulated.

Gastric fistulas, due to ulceration of the stomach while it is one of the hernial contents, may rarely occur. Small urinary fistulas may close spontaneously, provided there is no obstruction in the urethra.

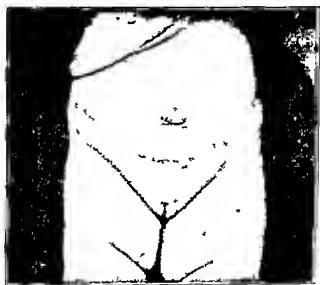


Fig. 133.—Umbilical hernia in a child.

**Umbilical Hernia in Infants.**—Umbilical hernia is often overlooked until the baby is a few weeks old, and a tumor is noticed when it cries. The small spherical protrusion, which first appears, becomes conical in shape as it increases in size (Fig. 153). A small hernia frequently causes attacks of colic, and the pain is relieved and the child stops crying as soon as the mass is reduced. These hernias usually contain a knuckle of intestine only when the child cries, omentum is seldom found in the sac, and strangulation is rare.

Reduction is promptly accomplished especially if the child is suspended by the feet to keep it from crying. The ring is easily felt by the examining finger. If the edge of the orifice is sharp, the outlook for spontaneous cure is less promising than when it is broad and symmetrical.

Gastrointestinal symptoms similar to those found in the adult will be noticed if the omentum has become adherent to the sac wall. While this condition is unusual in children, it should always be borne in mind.

**Umbilical Hernia in Adults**—Adult umbilical hernia may rarely be the persistence of the infantile form, or it may be a recurrence of an infantile hernia. As a rule, however, it first appears following an increase in intraabdominal tension and weakening of the muscle walls, which is usually caused by obesity or multiple pregnancies. The hernia increases most in size during the last weeks of pregnancy and at parturition. As in the infantile form, the adult hernia first protrudes through the *weak spot* of the umbilical cicatrix at the upper part where the obliterated umbilical vein is loosely attached to the edge of the ring.

In early cases an expansile impulse is obtained when the patient coughs, and the tumor is reducible when he assumes the recumbent position. If the hernia is grasped between the finger and lifted up, the contents may be felt to slip by the fingers. Umbilical hernia in adults first appears to come through the side of the ring, and for this reason has been termed "paraumbilical hernia." As it increases in size it assumes a rounded or oval shape with a marked tendency to sag downward, becoming pendulous. At this stage the hernia appears to be in the midline. In addition to the dilatation of the umbilical ring, there is usually more or less diastasis of the recti. These hernias have no tendency to spontaneous cure, on the other hand if left untreated they steadily increase in size and may reach large proportions in some cases extending to the symphysis pubis or even to the knees.

The sac almost always contains more or less omentum, transverse colon or small intestine, and rarely other viscera. Early in the course of the hernia the omentum becomes adherent to the sac wall, causing the mass to be partially or wholly irreducible. The large hernias often present several loculi or diverticula, which are formed by the adhesions between the omentum or by the adhesion of omentum to the walls of the sac. Sometimes the intestinal contents are entirely enclosed by folds of omentum which have become matted together. On account of the exposed position of the hernia, it is subjected to considerable mechanical irritation from corsets, trauma, rubbing of clothes, etc. The discomfort of a large umbilical hernia is often sufficient to make the patient a semi-invalid. Most patients complain of a dragging pain in the hernia if compelled to be on their feet for any length of time. In men umbilical hernia is usually associated with inguinal or femoral hernia.

When the greater omentum is adherent in the hernial sac, it produces traction on the stomach and transverse colon, which interferes with the peristaltic movements of the stomach and causes it to assume a vertical position. The gastrointestinal symptoms are often pronounced. Traction on the colon may cause attacks of colicky pain, constipation, nausea and vomiting.

Aaron has applied the term *umbilical dyspepsia* to those patients who have no demonstrable hernia but complain of indefinite gastrointestinal symptoms with nervousness. In these cases severe pain follows pressure over the umbilicus. Strapping with adhesive tape or the wearing of an elastic belt usually affords relief.

### Complications

**1 Gallbladder Disease**—When the gallbladder is part of the hernial contents it is usually manifested by sudden abdominal pain between the umbilical region and the liver which is aggravated by pressure over the ninth right costal cartilage and may be so severe as to compel the patient to go to bed. Gallstones, cholecystitis or gangrene of the gallbladder may be found at operation. Cholecystectomy is usually indicated.

**2 Ascites and Umbilical Hernia**—Ascites due to cirrhosis of the liver or to an abdominal tumor may enter the hernial sac and if omental adhesions are absent or slight the fluid may displace the viscera into the abdomen.

**3 Strangulation**—Strangulation is rare in children but is not uncommon in adults. Often the symptoms are obscure as the strangulation may be intrasacculary, and if the patient is very obese and the hernia small palpable signs may be absent. With a history of umbilical hernia the symptoms of intestinal obstruction, stercoraceous vomiting etc. operative intervention is indicated.

Obstruction in umbilical hernia is frequent because of the tendency of the omentum to adhere to the sac walls. I believe paralysis of the intestine in the sac is sometimes a contributing cause of strangulation. The fundus of the sac which is constantly exposed to mechanical irritation is frequently the seat of ulceration, sometimes so extensive that it involves the peritoneum. If the peritonitis is localized it usually results in a mass of adhesions. Occasionally the infection extends to the abdominal cavity. The diagnosis is very difficult if the symptoms simulate a superficial abscess of the abdominal wall.

**4 Rupture of the Sac**—Sometimes the hernial sac will suddenly tear after a strain or injury. Pott in 1763 cautioned against the disastrous results following rupture of the sac during pregnancy. Usually the skin over the fundus of the sac is already the seat of ulceration. Operation should be performed at once the earlier it is done the more favorable the prognosis. In the delayed operation almost all the patients die of peritonitis.

I observed an irreducible umbilical hernia in a woman fifty years old with ulceration of the skin, of about two months duration over the most prominent part of the tumor. In this condition the patient fell downstairs the sac ruptured at the site of the ulcer and a small loop of intestine protruded. I operated five hours after the accident and she made an uneventful recovery.

The mortality rate from rupture of an umbilical hernial sac depends on the promptness of operation. During the first twelve hours it is 25 to 50 per

cent, while those patients operated on twenty four hours or more after the accident nearly all die unless there are extensive adhesions in the sac to prevent intraabdominal peritonitis

### Differential Diagnosis

**Congenital Umbilical Hernia of the Cord**—There is small chance of mistaking congenital umbilical hernia for any other condition except possibly, hydrocele of the umbilical cord which might be confused with a urinary diverticulum. However hydrocele can be excluded by the absence of vesical symptoms and aspiration will show that the fluid is not urine.

**Umbilical Hernia in Infants and in Adults**—A subperitoneal lipoma which may come through an opening in the linea alba is frequently mistaken for an umbilical hernia. These fatty tumors give no impulse on coughing and do not disappear on manipulation or with change in posture.

Solid tumors myomas dermoids cysts in the umbilical region malignant tumors of the gastrointestinal tract cysts and syphilis involving the left lobe of the liver may rarely be mistaken for umbilical hernia.

### Prognosis

**Congenital Umbilical Hernia of the Cord**—In small congenital umbilical hernia the outlook is fairly good if the condition is recognized early the operation undertaken while the sac is still moist and before the hernia has been increased in size by the taking of fluid into the stomach. Unless the hernia can be reduced and the opening closed by operation the prognosis is very grave. Resection of viscera and incomplete closure of the defect are usually followed by death. Infants with large congenital hernia are often stillborn or die soon after birth. If other viscera besides the intestine are in the sac the infant has small chance of surviving operative treatment. Infants with small congenital hernia are usually born alive and the most favorable results have been secured when operation has been performed during the first few hours after birth. The mortality rate is about 10 to 20 per cent.

**Umbilical Hernia in Infants**—Infantile umbilical hernia is usually cured spontaneously before the third year. It seldom persists into adult life. As strangulation is rare the prognosis in these cases is good if the child is properly fitted with a binder or support.

**Umbilical Hernia in Adults**—Umbilical hernia in adults carries a graver prognosis than the inguinal or femoral variety. Rapid growth of fat in the omentum within the sac causes the hernia to become irreducible even if no adhesions have formed. As a rule adhesions form early between the contents and between the omentum and the sac walls. The transverse colon in the hernial sac tends to become dilated and as it is difficult for it to empty its contents strangulation occurs frequently.

Homans emphasizes the danger of operation on strangulated umbilical hernia since it carries a high mortality rate in obese or elderly persons probably 30 per cent in skillful hands as the jejunum is usually involved.



There is no tendency to spontaneous cure of adult umbilical hernia. Owing to the exposed position of the fundus of the hernia either a poorly fitting truss or trauma may produce irritation and finally ulceration which may result in perforation of the sac and fatal peritonitis.

On account of the sacculated condition of the hernia, it is important at operation to be on the lookout for a hidden strangulation of a small knuckle of intestine in one of the loculi. The mortality of operation for strangulated umbilical hernia is 10 to 50 per cent. The causes of death following operation for the large hernias can be most conveniently divided into three groups.

1 Death due to cardiovascular and renal complications dilatation of the heart pulmonary edema pneumonia uremia apoplexy, embolism and thrombosis.

2 Death caused by postoperative abdominal conditions postoperative obstruction acute dilatation of the stomach, peritonitis and suppuration of the abdominal wall acute pancreatitis perforation of gastrointestinal ulcer, appendicitis etc.

3 Death following strangulations toxemia from obstruction peritonitis from ruptured and gangrenous bowel and embolism of the mesenteric arteries.

Many of these conditions can be prevented by careful preoperative treatment a good operative technique, and efficient after care.

**Recurrence**—In a series of cases studied by Simmons the recurrence was lowest following the closure of the wound by transverse overlapping of the fascia. In 30 cases only 10 per cent recurred while in 45 cases in which other methods of closure were employed 22.2 per cent recurred. Recurrence takes place most often during the first six months after a year's time it is comparatively rare unless the wound is subjected to some severe strain such as pregnancy or excessive gain in weight.

### Treatment

**Congenital Umbilical Hernia of the Cord**—The treatment of congenital umbilical hernia may be either mechanical or operative.

**Mechanical Treatment**—Small congenital umbilical hernias can sometimes be cured by palliative measures which consist in keeping the parts clean and dry and using a bland dusting powder or ointment. Pressure on the tumor is maintained by wide adhesive strips passing two thirds of the way around the abdomen. These can be most effectively applied if the child is suspended by its feet while they are put on. In this position it does not cry, there is no increase in intraabdominal tension and the hernia is easily reduced. When the skin becomes irritated from the straps they should be temporarily replaced by a firm binder or an elastic belt.

**Radical Operation**—The operative treatment offers the best chance for a permanent cure in all patients in whom it can be used. Large hernias or eventrations in which the viscera are irreducible and there is no chance of closing the opening are inoperable. A few cases are on record in which the herniated liver has been successfully reduced and the opening closed. Stewart

saw a case in which the liver was so firmly adherent to the fundus of the sac that reduction was impossible. Benedict reduced the spleen successfully, and several operators have found a portion of the stomach in the sac.

The earlier operation is undertaken the more chance there is for recovery. It has been successfully performed one half hour after the child was born. A number of successful cases are recorded in the literature in which operation was performed within two to twelve hours after birth. Alder collected 72 cases from the literature and found that when operation was undertaken in the first twenty-four hours the mortality was 12 per cent, while after forty-eight hours it was 66 per cent.

The two methods of operation are the extraperitoneal and the intraperitoneal.

*Extraperitoneal Operation*—The extroperitoneal operation is used, as a rule, because it produces less shock and gives the lower mortality. The amnion and Wharton's jelly are separated from the underlying peritoneal layer of the sac, without opening the abdominal cavity. The edges of the hernial opening are freshened on both sides, the sac is folded over and sewed in place, and the muscle and skin edges brought together over it with strong sutures. The tendency of the wound to pull apart is lessened by applying firm adhesive straps around the body.

*Intraperitoneal Operation*—The intraperitoneal operation is used when for any reason it is necessary to open the abdomen to examine the viscera or to deal with peritonitis. If there is difficulty in reducing the liver, it usually can be accomplished by incising the linea alba to widen the opening, and by dividing the round ligament of the liver.

The following method is a satisfactory one. Make a small incision 1 inch (2.5 cm.) long at the lower part of the hernia, and with a gauze pad in the wound to hold back the viscera, freshen the edges of the muscles and fascia and draw them together by a through and through suture of silkworm gut. The first incision should be prolonged  $\frac{1}{2}$  inch (1.25 cm.), and a second suture introduced. In this way the operation proceeds until the upper margin of the hernial opening is reached when the sac is excised, the peritoneum closed with a running stitch, and the sutures are tied. (Fig. 154.)

*Infantile Umbilical Hernia*—The treatment of umbilical hernia in infants and children is most conveniently considered under four headings: prophylactic measures, mechanical treatment, the injection treatment, and operation.

*Prophylactic Measures*—To diminish the chance of the development of hernia, care should be exercised to avoid traction on the cord, it should be ligated 1 to 2 inches (2.5 to 5 cm.) from the abdomen, under strict aseptic precautions, and protected with sterile dressings until it separates and the granulating wound heals. An antiseptic dusting powder is often useful. The dressings can be kept free from ordinary contamination by covering the lower portion of them with collodion, oil silk, waxed paper, or adhesive tape. A snug abdominal binder should be applied and allowed to remain until the umbilical

centrix is firm. As oftentimes umbilical hernia does not appear for a few weeks or months after birth I have found that the linder should be left on some months longer than has been the custom—until the child is at least six months old.

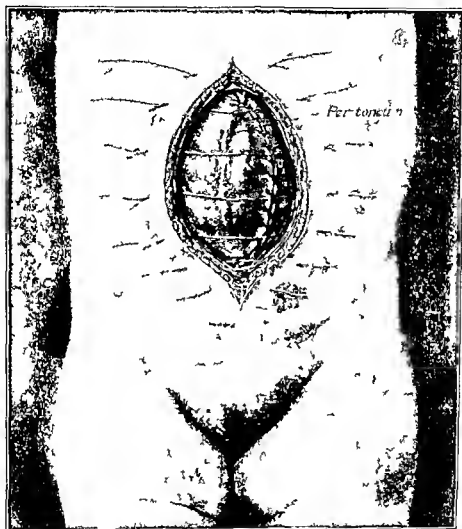


Fig. 154.—Intraperitoneal operation for congenital hernia of the umbilical cord. The sac is exposed, freed, opened, and the contents are reduced. A portion of the sac is excised and the peritoneal edges are united with a running suture. The skin, muscles, and fasciae are closed with interrupted sutures of silk worm gut linen or silk.

**Mechanical Treatment**—The mechanical treatment of small infantile umbilical hernias results in a high percentage of cures if it is used early. A ring with a sharp distinct outline usually closes more slowly than one that is indefinite and irregular. The length of time required for cure depends largely on the age of the child, the type of truss used, and the cooperation of the parents in carrying out instructions. If treatment is begun at the age of one month

about two months' time is required for a cure, if the child is three to six months old, the truss will have to be worn for at least six to nine months, if treatment is not begun until the child walks, it will take a year's time, or more, to effect a cure.

The better plan is to make a pad or compress, which must always be larger than the hernial opening, this pad can be made from sponge rubber or cork disk, and covered with soft flannel or muslin to prevent chafing. If it is smaller than the hernial opening it will tend to force the ring more widely open and will defeat the purpose for which it is intended. With the hernia reduced, the compress is placed over the center of the umbilicus with the convex side down, and held in position by a disk of adhesive plaster which is at least  $\frac{1}{2}$  inch (1.25 cm.) larger than the pad. The long adhesive straps are applied as the compress is pressed inward and the skin of the abdomen drawn in from each side. If the child is restless and crying, it is difficult to adjust the straps while the child is lying down, but it is a simple matter if the child is suspended by his feet. In this position the hernia does not protrude the child does not cry or kick, and intraabdominal pressure is not increased. The bandage should be changed every one to four weeks. (Fig 155.)



Fig 155.—Strip of adhesive plaster with covered button for the treatment of umbilical hernia in infants and young children.

After the child is one or two years old, a frame truss with a water pad is usually more satisfactory than the adhesive strapping. A bandage, belt or truss must be changed frequently to suit the growth of the child. For children under a year old whatever appliance is used should be kept on day and night, older children should wear a truss in the daytime and a light belt at night. The skin must always be kept clean and dry. It is not unusual to see adults with recurrent umbilical hernia that was apparently cured in childhood by truss treatment.

**Radical Operation.**—Operative treatment of infantile umbilical hernia is indicated when the hernia is large and causes frequent attacks of colic, vomiting and symptoms of partial intestinal obstruction, when the hernia cannot be held satisfactorily by a truss or bandage and when there is little prospect of cure by mechanical measures.

It is always possible to preserve the umbilicus, and for cosmetic reasons it is inexcusable to sacrifice it except in very large hernias. The incision is made either above or below the umbilicus preferably below, in the form of a half circle, about one third of an inch (8 mm.) from the hernia. If it is too close to the tumor, the nutrition of the flap will be interfered with. When the herniorrhaphy is combined with an abdominal operation, an incision at the

side of the umbilicus is the best. The neck of the sac is now exposed the flap turned up and the dissection continued entirely around the sac which is opened and the contents are reduced into the abdomen. A ligature is placed around the base of the sac, drawn tight and tied and the sac cut off. Reinforcing sutures are placed over the ligature. The separated rectus muscles are brought together and the fascia overlapped transversely, using silk or cotton sutures. The skin wound is closed by interrupted sutures and without drainage. Long adhesive strips are applied to hold the dressings in place and take the tension off the sutures. In a few months the cicatrix and umbilicus will be retracted and the cosmetic incision will be hardly noticeable (Figs 156-159).

Fig 157

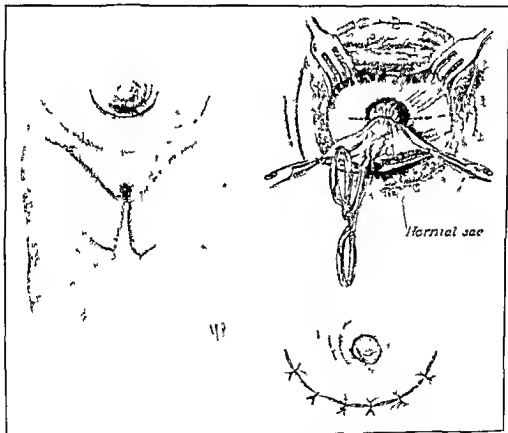


Fig 156

Fig 158

#### Operation for Infantile umbilical hernia.

Fig 156—The incision is made below the umbilicus in the form of a half circle about  $\frac{1}{2}$  of an inch (8 mm.) from the hernia.

Fig 157—The neck of the sac is exposed freed, the contents are reduced and the neck of the sac ligated. If additional room is needed short incisions can be made in the inner half of each rectus muscle.

Fig 158—The sac is opened excised, and the rectus muscles are brought together by interrupted sutures and the fascial flaps overlapped transversely and sewn with silk or cotton stitches. The subcutaneous tissues are closed and the skin edges sutured together. In a few months the incision is hardly noticeable.

In the very large hernias it may be necessary to use one of the operations described under adult umbilical hernia. Montoya uses transverse overlap of the fascia in infantile hernias and performs the operation under local anesthesia.

**Umbilical Hernia in Adults**—Umbilical hernia in the adult is always serious, because of the difficulties of treatment by both mechanical and operative measures. In obese subjects the amount of adipose tissue in the hernia should be reduced by a proper diet and exercise suited to their individual needs.

**Mechanical Treatment**—Small umbilical hernia in subjects of average weight can usually be controlled more or less satisfactorily by a truss of the frame type. For obese individuals with large hernias an elastic belt may be necessary.

The pad or plate that fits over the umbilical opening should be considerably larger than the hernial ring, and made of felt; however it can be made of metal, wood or hard rubber. It should have a deep center if the patient is obese.

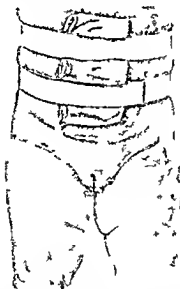


Fig. 159.—Operation for infantile umbilical hernia. Strain is taken off the sutures by applying two adhesive straps entirely around the abdomen.

The truss or belt should be applied with the patient in the reclining position. The pad should be placed a little below the center of the hernia; this is especially important if the subject is fat and has a pendulous abdomen. When the truss is properly adjusted it presses the hernia upward and backward when the patient is in the standing position.

Elastic belts if properly fitted will usually prevent the large hernias from increasing in size. The patient with a voluminous hernia should wear at night a light elastic belt that has an umbilical pad attached.

**Taxis**—While taxis is seldom employed at the present time the rules laid down by Cooper have not been improved upon. He directed that the abdominal muscles should first be relaxed by elevating the shoulders, raising

the pelvis and bringing the thighs to a right angle with the body. The physician grasps the tumor and lifts it up to a position opposite the umbilical opening. If the hernia is small direct pressure may be made upon it to force it into the abdominal cavity, if it is large pressure is aided by gently kneading the neck of the sac. Often massage, with a rotary motion over the fundus of the hernia will hasten reduction.

Other palliative measures that are useful in irreducible hernias are rest in bed, restricted diet, firm pressure over the tumor by means of a bandage and the application of an ice bag. Some surgeons use hot applications but I have found that if the skin is irritated or ulcerated there is less danger of sloughing if cold applications are used.

Taxis or palliative treatment of any kind must never be attempted if symptoms of strangulation are present.

For irreducible hernia I use a concave felt pad with a run extending a little beyond the limits of the hernia. If the hernia reduces under this treatment the pad is correspondingly decreased in size. It is often most comfortable for the patient to wear an elastic belt beneath the truss. Irreducible hernias cause considerable discomfort besides the constant danger of obstruction and strangulation and the radical operation is always to be advised.

When the patient is very obese it is sometimes difficult or impossible to palpate a small strangulated umbilical hernia; consequently the physician may continue palliative treatment longer than he would if he could feel a tumor to confirm his tentative diagnosis. In the presence of vomiting, constipation, severe pain with or without tenderness in the umbilical region and a history of an old umbilical hernia it is advisable to make an exploratory incision of the hernial sac under local anesthesia to aid diagnosis.

I recall the case of a woman who became ill during the night with severe and constant pain in the epigastrium. When the attending physician called me twelve hours after the onset of symptoms he said that he had "all the symptoms of a strangulated umbilical hernia except a tumor." I found her very obese; there was no history of hernia and only slight tenderness over the region of the umbilicus. I made a diagnosis of strangulated umbilical hernia and at operation under local anesthesia I found a sac the size of a hen's egg containing a knuckle of strangulated intestine.

*Preoperative Treatment*—Except in strangulation patients with irreducible hernia should be subjected to two to four weeks' preliminary treatment to decrease the amount of fat in the hernia so that it can be reduced and to diminish the volume of fat in the abdomen so as to provide room for the extrabdominal viscera. This precaution lessens the danger from such postoperative complications as acute dilatation of the heart, edema of the lungs, pneumonia and renal insufficiency which frequently follow the sudden increase in intraabdominal tension on the return to the abdominal cavity of a viscus, which perhaps has not been there for years and has lost its right of domicile. Prolonged rest in bed with or without pressure on the tumor by a binder or weight was used by the ancients in the treatment of irreducible hernia.

The difficulties and dangers of operating on voluminous irreducible hernias, as well as the chance of recurrence, are lessened if the hernia is reduced as much as possible before operation is undertaken. Many cases are recorded in the literature in which operation has been attempted on these large hernias, without preliminary treatment, and it was found impossible to return the herniated viscera into the abdominal cavity. In other instances, although it was possible to return the viscera, the tension was so great that the patient quickly succumbed, usually from acute dilatation of the heart or from pulmonary edema.

Preoperative reduction of an irreducible hernia is best accomplished by rest in bed, a restricted diet or a varied diet with sufficient calories to prevent weakness, mild saline purges, and repeated gentle taxis. The use of a tightly fitting binder is better and safer than taxis, and has been strongly advocated by Hahn and McGlannan.

Arnand, in the eighteenth century, wrote that the hernia should be reduced slowly, because if the procedure was too rapid the patient suffered from colicky pains. The binder should extend from the ensiform cartilage to the symphysis pubis, and to prevent abdominal contents from being forced into the sac, pads should be used on certain parts of the hernia to equalize the pressure over the entire tumor. The binder should be tightened each day, increasing the pressure as much as the patient can stand it. Sandbags will often aid reduction. Functional kidney tests will determine whether or not the patient is a safe operative risk. Unfavorable symptoms which contraindicate the operation are irregular or rapid heart action, changes in blood pressure, respiratory and gastrointestinal disturbances. As a rule, the weight should be reduced 20 to 50 pounds before operating. If general anesthesia is used the amount should be as small as possible.

*Anesthesia*—Spinal anesthesia is suitable for the good risk patient. It is contraindicated when the systolic blood pressure is below 120 mm. When the patient is gravely ill, advanced in age, or otherwise a poor risk, local anesthesia should be used.

*Postoperative Complications*—Because of the poor physical condition that is the rule in patients with massive umbilical hernia, postoperative distention, when added to the increased intraabdominal tension due to the operation, is dangerous. The disturbances in the cardiovascular system together with the embarrassed respiration, make these patients favorable subjects for pneumonia, edema of the lungs, sudden cardiac failure, acute dilatation of the stomach, jaundice, and gastrointestinal hemorrhage.

*Radical Operation*—The radical operation is always to be recommended for umbilical hernia in adults except in the presence of definite contraindications, such as advanced cardiorenal or pulmonary diseases, or when there is no prospect of reducing the hernia and closing the opening. On account of the constant danger of strangulation in large irreducible hernias, the outlook is grave, and the indications for operative relief are more urgent than in other varieties of nonstrangulated hernia. It is often difficult to sterilize the skin on account of the deep folds of the umbilicus and the frequent irritation and



occasional ulceration over the fundus. The application of antiseptic dressings one or two days before operation is helpful.

The patient should be placed on the operating table in the horizontal position. (The Trendelenburg position is dangerous.) If the shoulders are slightly raised, the pelvis elevated and the thighs flexed, reduction of the contents will be facilitated and closure of the wound accomplished more easily.

**Incision**—An elliptical transverse incision is made below the hernia and a second one above it, to include nearly the whole of the skin overlying the hernia. These incisions meet at the *lineae semilunares* (the outer borders of the recti muscles). In very large hernias or in patients with pendulous abdomens, the incisions will include not only the hernia and the umbilicus, but a large amount of redundant skin and subcutaneous fat, and it may be necessary to extend the ends of the incisions beyond the *lineae semilunares*. The incision is now carried straight down to the aponeurosis, two to four inches (5 to 10 cm.) from the neck of the sac. (Fig. 160.)

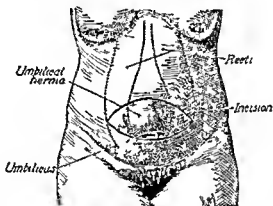


Fig. 160—Operation for umbilical hernia in adults. An elliptical transverse incision is made below the hernia and a second one above it to include nearly the whole of the skin overlying the hernia. These incisions meet at the *lineae semilunares* (the outer border of the recti muscles). In large hernias the incisions must be longer.

It is easy to find the line of cleavage between the layers of fascia when the dissection is begun some distance from the umbilical ring, where the layers are not closely adherent. The hernial mass and fat are dissected toward the umbilical ring until the neck of the sac is exposed all the way around, so that the protrusion, which is covered by undisturbed skin and fat is attached to the abdomen only by its neck. The umbilicus may be left to facilitate approximation of the wound.

Hemorrhage is minimized if mild traction is made on the hernial mass during the dissection, and if small blood vessels are ligated before being cut.

**Sac**—The sac is opened near the neck or through the aponeurotic ring at the outer side of the sac. It is opened here because at this point there is small chance of encountering adhesions, and little danger of wounding the hernial contents. On account of adhesions in the sac, the viscera, especially the omentum, are liable to be wounded if the sac is opened at its fundus, and intestine is most frequently found at the upper part of the ring. (Fig. 161.)

The adhesions are separated and the hernial contents reduced into the abdominal cavity. Before this can be done, it is usually necessary to enlarge the umbilical ring, first below the neck of the sac, and if still more room is required to relieve the constriction, a second incision can be made above the sac. The point of constriction is in the fascia, which can be divided without entering the abdomen.



Fig. 161.—Operation for umbilical hernia in adults. The sac is opened near the neck or through the aponeurotic ring at the outer side of the sac. At this point there is small chance of encountering adhesions, and there is little danger of wounding the hernial contents.

*Omentum.*—Considerable time is saved if no attempt is made to separate the omental adhesions in the sac. These large masses of fat should be ligated and cut away at the point where they emerge from the abdomen. As much of the omentum as possible should always be removed, so as to avoid raising

the intraabdominal tension any higher than necessary. The danger of embolism is lessened if the adherent omentum is ligated by multiple ligatures of silk or cotton each of these including a small section of omentum from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch (0.6 to 1.25 cm) in width. The sac with its adherent omentum as well as the overlying skin and umbilicus is cut away in one mass. As the peritoneal sac is cut away, the margin is caught with hemostats and no effort is made to close the sac separately except perhaps in very small hernias. (Fig. 162.)

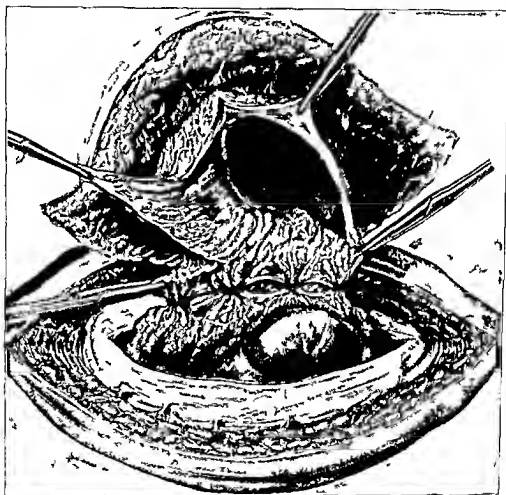


Fig. 162.—Operation for umbilical hernia in a child. Considerable time is saved if no attempt is made to separate the omental adhesions in the sac. These large masses of fat should be ligated and cut away at the point where they emerge from the abdomen. In this way the sac, the adherent omentum, the overlying skin and the umbilicus are cut away in one mass.

If it is impossible to separate the intestine from portions of the sac wall the latter can be trimmed around the adhesion and the edges united by sutures so as not to leave any raw surface exposed.

*Reducing the Contents of the Sac*—If difficulty is experienced in reducing the loops of intestine after the constricting ring has been enlarged forceps are applied to both edges of the wound and it is lifted up. A large laparotomy

pad or a small towel is spread over the hernial contents and tucked in beneath the abdominal wall entirely around the opening. The hernia is now reduced by making firm pressure on the pad with the outspread fingers of one or both hands while an assistant applies tenaculum forceps to approximate the edges of the wound as fast as the hernia is reduced.

*Resection of the Intestine Outside the Abdomen*—Resection of the intestine lying in the hernial sac is sometimes necessary in dealing with very large irreducible hernias. Only sufficient intestine should be resected to permit reduction of the sac contents and as much of the ileum as possible should be left on account of the severe diarrhea and other metabolic disturbances that follow excision of this portion of the small intestine. Manipulation of the intestine that has lost its *right of domicile* does not produce as much shock as the handling of intrabdominal intestine.

### Closure of the Umbilical Ring

*Transverse Overlapping of the Fascia*—The best method of closure is by a transverse overlapping of aponeurotic flaps as first used by Mayo in 1894. A transverse incision 1 to 3 inches (2.5 to 7.5 cm) long is made in the aponeurosis on both sides of the umbilical ring. The flaps are freed from all overlying fat for a distance of at least 2 to 3 inches (5 to 7.5 cm). If the hernia is small it is usually possible to approximate the recti muscles by interrupted sutures. This step is unimportant and usually impossible in large hernias. The fascial flaps are overlapped for 2 to 3 inches (5 to 7.5 cm) from above downward by interrupted sutures of silk or cotton. A strong curved needle is passed from without in through the upper flap 2 to 3 inches (5 to 7.5 cm) from its margin and in large hernias it passes through the entire thickness of the aponeurosis and peritoneum and then transversely through the whole thickness of the lower flap about  $\frac{1}{4}$  inch (6 mm) from its margin. The needle is then carried back through the hernial opening into the peritoneal cavity and made to emerge  $\frac{1}{2}$  inch (8 mm) lateral to the point of original entrance into the upper flap. One or more additional sutures are passed on each side of this central mattress suture until the opening is completely closed. After all the sutures are inserted they are tied by being drawn tight and pulling the entire thickness of the lower flap behind the upper flap. The upper flap is now retracted the suture line exposed and if there is any gap it is closed by sutures to prevent a tongue of fat or omentum slipping through. Slit cuts in the fascia should always be sutured otherwise they are sites of potential hernias. The lower edge of the upper flap is fastened to the outer surface of the lower flap with a continuous suture or interrupted sutures. (Figs 163 and 164)

*The Author's Modification*—I have found that the flaps can be more accurately and firmly approximated if the lower flap is pulled through a narrow slit in the upper flap and sutured at intervals of 1 to 2 inches (2.5 to 5 cm) instead of using the mattress sutures. The edge of the upper flap is sewed to the anterior surface of the lower flap by a suture of fine silk or cotton. The skin and superficial fat are closed and the patient is kept in bed twelve to twenty days. (Fig 165)

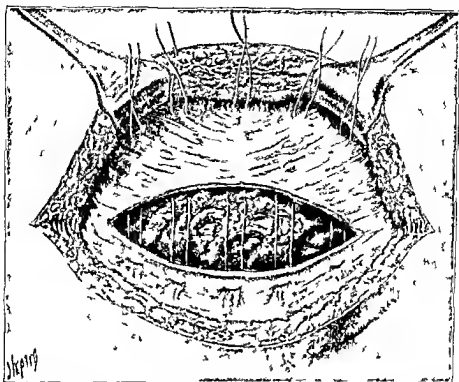


Fig. 163—Operation for umbilical hernia in adults. Transverse overlapping of the fascia. The best method of closing the umbilical ring is by transverse overlapping for two to three inches (5 to 7.5 cm.) of aponeurotic flaps from above downward by interrupted mattress sutures (Mayo operation.)

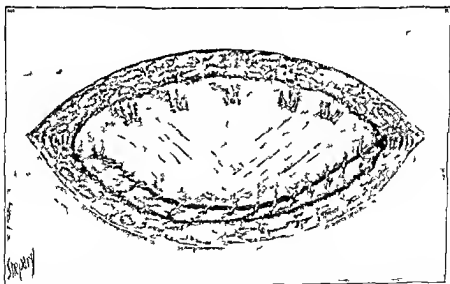


Fig. 164—Operation for umbilical hernia in a child. The sutures are drawn tight and tied thus pulling the entire thickness of the lower flap behind the upper flap. The free edge of the upper flap is fastened to the anterior surface of the lower flap by a continuous suture or interrupted stitches (Mayo operation.)

**Closure of Subcutaneous Tissues and Skin.**—The thick layer of subcutaneous fat must be carefully closed by one or two layers of sutures. Care should be exercised to avoid leaving any "dead spaces" where blood or serum may collect. As a rule, drainage should be avoided, as in all clean hernia operations primary union is more prompt without it. However, when drainage is required, I prefer a stab-drain made below or to one side of the skin closure, and a wick of soft rubber or gutta serena tissue inserted. A fluffed gauze dressing is applied and held in place by adhesive straps passing around the body, or by a scultetus bandage

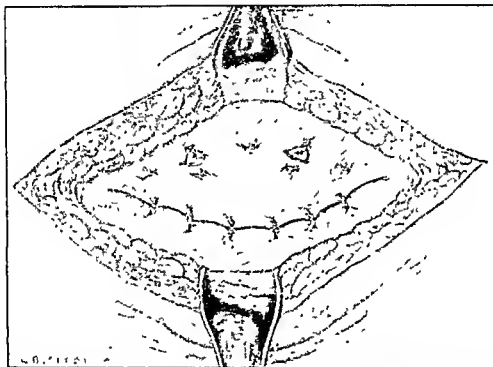


Fig 165.—Operation for umbilical hernia in adults. The author's modification of the Mayo operation. Sometimes the flaps can be more accurately and firmly approximated if the lower flap is pulled through a narrow slit in the upper flap and sutured at intervals of 1 to 2 inches (2 1/2 to 5 cm.), instead of using mattress sutures. Finally the edge of the upper flap is sewed to the anterior surface of the lower flap by interrupted sutures.

Mahorner overlaps the tissues longitudinally with interrupted silk sutures. The fascia of the posterior rectus sheath is sutured; then the rectus muscles are stitched; the anterior rectus sheath is overlapped and sutured, fascia strips are passed transversely across the wound and sutured to anterior rectus fascia near the linea semilunaris, to relieve tension in the wound. The subcutaneous tissues and skin wound are closed in the usual manner.

**Mortality Rate Following Operation for Nonstrangulated Umbilical Hernia.**—In the 600 operations for nonstrangulated umbilical hernia that I collected from the literature, there were 9 deaths (1.5 per cent).

**Lipectomy.**—More or less fat is always removed during the course of an operation for umbilical hernia in adults. The wide excision of fatty flaps in the pendulous abdomens associated with umbilical hernias is to be recommended.

*Indications for Lipectomy*—A pendulous abdomen associated with the following symptoms calls for a lipectomy: a continuous heavy dragging sensation over the stomach, bickering, and intestinal disturbances which are due to an elongated mesentery.

*Operation*—The removal of a wedge shaped section of fat gives better access to the umbilical ring, facilitates the suturing, and lessens the tendency to recurrence. The vertical width which is to be removed is ascertained by lifting up the abdominal wall until the pendulous suprapubic fold of tissue disappears.

The best incision for lipectomy from a cosmetic standpoint, is a vertical one. With the transverse incision, unless the fat is carefully trimmed, there will be unsightly hornlike projections at each end of the incision. There is no reaccumulation of fat if the patient watches his diet, and his personal comfort as well as his appearance is very much improved. (Fig 166.)

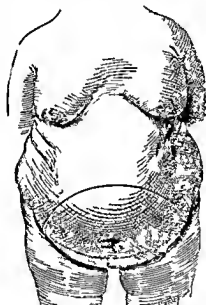


Fig 166.—The operation for umbilical hernia combined with lipectomy in adults. In patients with pendulous abdomens the removal of a wedge shaped section of fat gives better access to the umbilical ring, facilitates the suturing, and lessens the danger of recurrence.

**Strangulated Umbilical Hernia in Adults**—The majority of umbilical hernias are irreducible, and the patient is accustomed to considerable pain, discomfort, and occasional attacks of partial obstruction so that when strangulation does occur it is often not recognized until the most favorable time for operation has passed. The strangulation is frequently intrasacral and is often due to omental adhesions in the sac. On account of the enfeebled physical condition of these patients who are usually advanced in age or have fatty hearts and arteriosclerosis, discretion must be used in the extent of the operation to which they are subjected. As a rule the safest plan is merely to relieve the

strangulation under local anesthesia and leave the radical operation for a future time when the patient is in a better condition.

The mortality of strangulated umbilical hernia has been very high (10 to 50 per cent). In 55 cases collected from the literature by Vulpius there were 9 deaths. Several factors are responsible for this high rate: difficulty in diagnosis, delayed operation and use of general anesthesia and the attempt to complete the radical operation when the patient's condition does not warrant it. White stated that in 39 consecutive cases of umbilical hernia in patients sixty-eight to eighty years of age the mortality rate was 33 per cent. In emergency operation for strangulation only the constricting ring was incised and the mortality was 48 per cent.

The best and quietest method of dealing with strangulated hernia by the one-stage operation is to open the neck of the sac at the side and complete the circular incision of the sac with scissors. In this way the fibrous ring is removed with the sac. The hernial sac is now opened from the inside with scissors and the contents are dealt with as their condition demands.

### Postoperative Treatment

**Early Rising After Hernia Operations**—Rest in bed after hernia operations has been a subject of considerable controversy among surgeons. I believe it is best to encourage the patient to turn in bed, move his arms and legs and sit up in bed two or three times for a few minutes on the first day. Have him get out on the floor for a few minutes the second day and gradually increase the time out of bed each succeeding day. In less than a week all weakness disappears and he can get around alone.

Early rising has many advantages. It practically eliminates postoperative pulmonary complications. Other complications are usually nonexistent. The patient's vital capacity is not lowered as it is when he is kept recumbent. There is less tendency to cough. Less postoperative temperature. Wound healing is improved and there are no more recurrences than following a week or two in the recumbent posture.

The only contraindication to early rising is a very large hernia or the patient's being very obese. He should be kept recumbent for five to seven days and should wear a snugly fitting elastic belt for a year or longer. He must be warned of the danger of recurrence and instructed to avoid a gain in weight. He should not undertake any exercise or work that will put a strain on the wound.

**Typanites**—Gas pains are prevented by use of the Wangenstein continuous suction tube to keep down abdominal distention. A catheter or small rectal tube to carry off gases from the lower bowel adds to the patient's comfort. Alkalis and glucose should be administered to combat acidosis preferably by venoclysis. The routine use of cathartics should be avoided.

**Preoperative and Postoperative Treatment of Strangulated Hernia**—Before operation fluids should be administered intravenously to restore the body level that has been lowered by nausea and vomiting. One should re-



member too much fluid is dangerous as it may cause pulmonary edema. Blood transfusion is usually advisable to replace blood cells and minerals. Distention of the abdomen should be reduced by the use of the Wangensteen suction tube in addition to the usual low rectal tube. The bladder should be emptied by a catheter just before operation.

**Anesthesia**—Spinal anesthesia is suitable for the good risk patient. It is contraindicated under the following conditions, when the systolic blood pressure is below 120 mm, when it is very high, in cerebrospinal disease or paralysis, in infants and children, when the patient is gravely ill, advanced in age, or otherwise a poor risk, in such cases local anesthesia should be used.

The postoperative treatment of strangulated hernia should include the breathing of 95 per cent oxygen to help displace by diffusion the nitrogen contained in the distended or strangulated bowel also blood transfusion and physiological salt solution to replace loss of blood cells and minerals by vomiting or otherwise and vitamin C to hasten wound healing.

An impaired circulation or damaged myocardium is benefited by a 50 per cent dextrose or glucose solution, giving 100 to 200 cc by venoclysis twice daily before and after operation. The addition of some form of chloride is also helpful. Penicillin, 20 000 units hypodermically every three hours, one day before operation and two days postoperatively is advisable to combat infection. If administered orally, the dose units should be tripled.

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## CHAPTER XXII

### INCISIONAL AND VENTRAL HERNIA

**Synonyms**—*Iaparocoele* postoperative hernia, ventrocoele

**Definition**—Ventral hernia is a protrusion of abdominal viscera through the anterior abdominal wall occurring at points other than the inguinal femoral or umbilical openings or in the linea alba

Incisional or postoperative hernia may appear anywhere in the abdominal wall and constitutes 15 per cent of all hernias. Traumatic hernia is also termed *accidental incisional postoperative* or *cicatrical hernia*. It may be due to direct injury, such as a crushing blow or a fall from a height but the most common causes are postoperative suppuration in the abdominal wall the use of drains that are larger than necessary faulty closure of the muscle and fascial layers and the division of nerves supplying the muscles. Unusual causes are tumors in the abdominal wall hematomas distention and weakening of the abdominal wall due to obesity ascites or intraabdominal tumors.

The hernia may appear immediately after injury as true traumatic hernias do but when it is postoperative it may not be noticed for several months as the scar tissue is distended and gives way slowly while the hernia is small. These hernias may occur anywhere in the abdominal wall they are most frequent after operations for appendicitis. Sometimes they come through following a midline incision operation in the linea alba and occasionally they arise from an operation on the gallbladder.

**Frequency of Incisional Postoperative Hernia**—Incisional hernias are more frequent than statistics show. Two factors are responsible for this state of affairs. (1) The operation is often performed as an emergency or hurriedly to relieve symptoms. It is natural to make the abdominal incision in the quickest and easiest way without considering the subject of postoperative hernia. (2) If the hernia operation is not an emergency it is still an unfavorable risk.

Incisional hernias most frequently develop in obese subjects past middle age. Too often a pendulous abdomen complicates the hernia as most postoperative ventral hernias occur in women. Some so-called incisional hernias are due to thinning or lack of muscle support over the scar the result of cutting the nerve supply or failure to close the deep muscle and fascial layers securely. With more carefully planned abdominal incisions the incidence of postoperative hernia will lessen. An incisional hernia occurs after 2 to 5 per cent of all clean abdominal operations and in 15 to 30 per cent of infected and drainage cases. In a series of hernias reported by Benjamin 21.6 per cent followed operations for appendicitis 11.2 per cent were the result of gallbladder operations and there was a recurrence rate of 36 per cent in operations for incisional hernia.

A planned incision for each operation should be worked out. Sloan, Cortes, Singleton and Blocker and others have demonstrated that a lateral transverse incision lessens the danger of wound disruption and postoperative hernia.

In 1887 Homan estimated that 10 per cent of all abdominal operations were followed by hernia. In 1892 Marey found that by using absorbable suture material his recurrence was reduced to 1 per cent. Nigst observed 14 hernias in a group of 117 drained appendectomies. There is less tendency to hernia with the McBurney incision. The edges of the wound must always be sutured close up to the drainage tube, which should be as small as possible. A drain should never be used in clean cases but when one is necessary, I prefer it made from a wick of gutta serena or rubber tissue.

In a series of 500 laparotomies reported by Stanton, the midline or rectus incisions gave less than one half of 1 per cent of hernias. In 260 clean cases, only 3 postoperative hernias developed, while in 186 operations in an infected field, 18 hernias resulted. In 35 cases of postoperative hernia observed by Warren, 13 followed appendectomies and 22 developed after median and para median laparotomies. There were 2 cases of strangulation in this group. These 35 patients were operated on without a fatality. Warren reported 1,000 appendectomies through a McBurney incision and estimated the postoperative hernias at 2 per cent. Huard wrote on the frequency of right inguinal hernia developing after the operation for appendicitis. Monterio and Wazen recorded their observations from a study of 302 operations on the anterior abdominal wall.

**Symptoms and Diagnosis**—Incisional ventral hernias offer no difficulties in diagnosis, the symptoms are those common to all hernias and the tumor may reach large proportions. The scar of the former operation is discernible on the surface of the hernia. These large incisional hernias are held in at the neck by a firm ring of fascia. Beyond the confines of this constriction, the hernia has a tendency to spread out in the shape of a mushroom and to burrow outward beneath the subcutaneous tissues. The usual direction of greatest enlargement is downward. In massive incisional hernia, the pendulous tumor may reach to the knees.

**Strangulation**—Strangulation is not common in traumatic ventral hernia because the ring is large. When it does occur, however, the point of constriction is usually found at the neck of the sac in the aponeurosis of the external oblique. In rare instances there is a second point of constriction at the level of the peritoneal opening. Intrascapular strangulation occurs occasionally as it does in umbilical hernia.

**Rupture of the Sac**—Due to its exposed position the skin over the fundus of the sac is subjected to occasional contusions and to irritation and dermatitis caused by the rubbing of clothing. This inflammation produces omental adhesions within the sac and a thinning of the overlying structures; consequently, this point is often the seat of ulceration. Sometimes the sac will suddenly tear, following a strain or fall, and intestine will escape through the rent, in this event, operation should be performed, and the earlier it is done the more favorable the prognosis.

In almost all the delayed operations that have been reported, the patients have died of peritonitis. The tear in the sac may be very small.

**Prognosis**—Incisional ventral hernias have no tendency to spontaneous cure. On the other hand, they progressively increase in size and are almost

impossible to control with a truss on account of the large hernial ring. For this same reason strangulation is uncommon. The large hernias are frequently irreducible on account of the rapid growth of fat and omentum within the sac. Intrascicular adhesions form early both between the contents and between the omentum and the sac walls. The skin over the fundus of the hernia is often the site of irritation and ulceration. The sac occasionally ruptures making the prognosis grave. Patients with large irreducible hernias often become confirmed invalids unless relieved by operation.

**Wound Disruption After Abdominal Operations**—Ventral hernia is associated with wound excoriation and disruption when the problem of secondary repair presents itself. Although the condition is comparatively rare, disruption is frequent enough to be borne in mind in certain subjects as well as the measures for combating it. The principal causes of wound disruption are improperly placed incisions which disregard the nerve and blood supply, absorbable suture material, infection, and an ill-nourished or debilitated patient who is deficient in vitamin C and protein in the blood serum. Other factors that predispose to a breakdown of the wound include infections, hematomas, faulty closure of the peritoneum resulting in edema and exudate in the deep suture line, increased intraabdominal tension, and lag in wound healing due to a systemic cause, anemia, debility, marked loss of weight, sensitivity of the tissues, and improper suture material (silk or cotton should be used for all abdominal wounds). Disruption usually occurs from the fourth to the tenth day after operation.

Tashiro made an extensive study of wound disruption, and Glenn and Moore made a study of 22 cases. Hartzell, Winfield, and Irvin reviewed the subject at length.

**Treatment of Wound Disruption**—Poor risk patients should always receive a course of treatment before operation so as to avoid this accident. Lund and Crandon in discussing human wound healing point out that scurvy has long been recognized as a factor in delayed wound healing.

A low ascorbic acid and plasma level calls for a week's preoperative and several days' postoperative treatment, daily doses of 1000 mg. of ascorbic acid and vitamin B complex, preferably intravenously or intramuscularly, transfusion for a low red blood cell count, a high-calorie diet of proteins, fats, carbohydrates, and fluids. D'Ingrann reported the case of a patient who received the above treatment for ten days before operation and still the wound disrupted on the ninth day. There was no infection and recovery followed resuturing of the wound.

## HERNIA IN THE LINEA SEMILUNARIS

**Synonyms**—Hernia in the semicircularis Spigelii or Spiegel's hernia, *masked hernia*, *Laparocèles spontaneés*.

**Definition**—A protrusion of abdominal viscera through a weak spot in the linea semilunaris or the semilunar fold of Douglas where the posterior rectus sheath is deficient. From an etiologic standpoint ventral hernias are

customarily divided into two varieties spontaneous or acquired and traumatic or incisional. There are several types of the spontaneous variety: hernia in the linea alba, hernia in the linea semilunaris, hernia in the linea transversa and hernia in the sheath of the rectus muscle. Spontaneous hernias may rarely occur in the space bounded by the posterior border of the external oblique muscle behind the false ribs above and the iliac crest below. The traumatic or incisional hernias may appear anywhere in the median or lateral abdominal wall.



Fig. 107.—Point of exit of spontaneous hernia in the linea semilunaris

**Spontaneous**—Spontaneous ventral hernias are rare. The variety that occurs most frequently is hernia in the linea semilunaris and the opening is situated between the fibrous edge of the semilunar line and the rectus muscle. The hernia may occur through the outer edge of the linea semilunaris or

through the linea transversa or through an opening in the lower portion of the aponeuroses of the external and internal oblique muscles between the iliac crest and the false ribs or through the rectus muscle and fascia (Fig 167)

### Historical

LaChausse in 1721 was probably the first to recognize hernia in the linea semilunaris he called it a "rare and hidden species of hernia" LeDian also described the condition in 1731

In 23 cases of hernia in the linea semilunaris collected by Cooper, only four occurred above the navel In 1919 Harthélemy could find reports of only 22 cases of true spontaneous hernia in the linea semilunaris to these he was able to add one case of his own

Angeletti, in 1927 published an extensive paper on the etiology of Spiegel's hernia Pozzi in 1931 discussed the diagnosis Baehy in 1937 wrote at length on the subject and reported a case of hernia and Junet observed a case This was followed in 1938 by Bonetto and by Derycke who recorded cases of Spiegelian hernia Saiot in 1941 was able to collect 92 cases from the literature and added one of his own Cabillero in 1945 observed a case of spontaneous hernia McVay in 1946 also reported a case I recently observed a case in a young man thirty years of age Several surgeons had examined him and maintained he was malingering His symptoms disappeared after the cure of his hernia

### Anatomy

**Lineae Semilunares**—The lineae semilunares are two curved tendinous lines situated on each side of the linea alba and joined to the latter by the lineae transversae Each semilunar line extends from the cartilage of the ninth rib to the pubic spine and corresponds to the outer border of the rectus muscle The linea semilunaris is formed by the aponeurosis of the internal oblique at its point of division to enclose the rectus muscle where it is reinforced for its upper three fourths by the external oblique in front and the transversalis behind At the junction of the upper three fourths with the lower fourth the posterior sheath of the rectus terminates in a thin curved margin having its concavity downward and is known as the semilunar fold of Douglas In the lower fourth of the rectus the aponeuroses of the external and internal oblique and transversalis pass in front of the rectus muscle The extremities of the folds of Douglas descend as pillars to the os pubis (Fig 168) A majority of hernias in the lineae semilunares occur close to the pubes and are commonly classed as direct inguinal hernias Feeles terms these "ventro inguinal hernias"

The normal banding of the abdominal muscles has been studied as a cause of ventral hernia by Zimmerman Anson Morgan and McVay They found the external layer was the most uniform in arrangement while the internal oblique and transversalis muscles were the most variable and were the main factors in the etiology of ventral hernia

Hernias in the linea semilunaris are often divided into two varieties those appearing above the deep epigastric artery and those below it

\*Hernias above the deep epigastric artery are very rarely above the umbilicus. Hernias below the deep epigastric artery and on a level with the

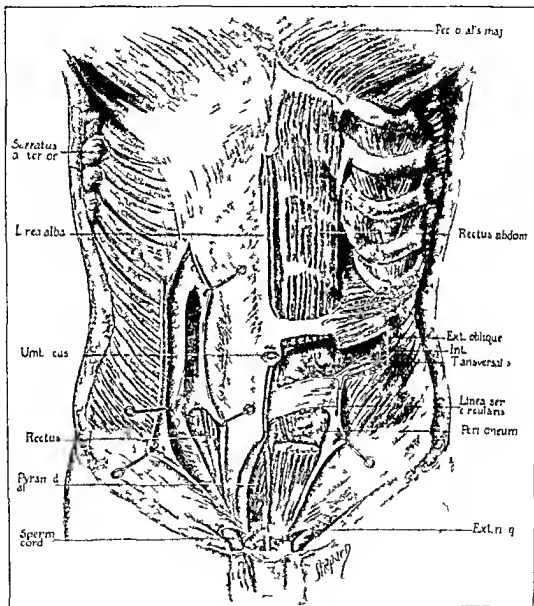


Fig 168—The superficial and deep anatomy of the anterior abdominal wall

semilunar fold of Douglas are the more common. They appear between the deep epigastric artery and the edge of the rectus muscle in Hesselbach's triangle. (These hernias are fully described under direct inguinal hernia.)

**Hernial Opening**—The hernial opening is usually situated at the weak point the semilunar fold of Douglas where the posterior rectus sheath is de-



sufficient. This hernia is nearly always found at the inner third of a line passing from the anterior superior spine of the ilium to the umbilicus. In the beginning the tumor is interstitial, deeply situated and difficult to outline. Later on it becomes subcutaneous and is easily found under the thin layers of the abdominal wall. It is always at the outer edge of the rectus at the point where the posterior sheath forms the fold of Douglas.

The *linea semilunaris* can be outlined by drawing a curved line with its convexity outward from the end of the cartilage of the ninth rib to the pubic spine. The center of the curved line at the umbilicus or near it should be 3 inches (7.5 cm.) from the median line (Gray).

The hernia may have more than one opening. In rare instances a portion of the hernia is subcutaneous and the remainder is interstitial or there may be two diverticula, one subcutaneous and the other properitoneal. Hernias in the *linea semilunaris* are usually interstitial and situated beneath the external oblique aponeurosis and in front of the transversalis fascia. Macready termed these 'masked hernias.' The hernial orifice is usually narrow and crescent shaped.

**Hernial Sac**—There is always a sac in spontaneous hernias in the *linea semilunaris*. It is globular, gonoid or mushroom shaped depending on its size. In front of the sac there will often be a lipoma which may constitute the bulk of the mass. In the large hernias the peritoneum is frequently adherent at the ring and is difficult to separate on account of the thinness of the sac. Traumatic eventrations are almost always without a sac.

**Contents of the Sac**—Omentum and small intestine are most often found in the sac. The large intestine, cecum and sigmoid are seldom present in reducible hernia. In strangulation large intestine is usually found.

**Size of the Hernia**—The spontaneous hernias in the *linea semilunaris* are usually quite small, sometimes the size of a hen's egg and very rarely as large as an orange. (Fig. 169.)

**Hernia in the Linea Transversa**—The *linea transversae* are narrow transverse fibrous lines that intersect the recti muscles and connect the *linea alba* with the *lineae semilunares*. One of the transverse fibrous bands is at the level of the umbilicus, one opposite the tip of the ensiform cartilage and another midway between the ensiform and the umbilicus. In rare instances there is a transverse line below the umbilicus. The *linea transversae* extend only through the anterior half of the recti muscles.

**Hernia in the Sheath of the Rectus Muscle**—Hernia in the sheath of the rectus muscle is very rare and always follows rupture of the rectus muscle and its fascia. It almost always occurs below the umbilicus where the posterior part of the sheath is thin. The omentum is usually found in these hernias as in the case reported by LeDran in 1731. When irreducible the hernia cannot be distinguished from hernias in the semilunar or transverse lines except by operation.

**Absence of Abdominal Walls**—In absence of the abdominal walls or a lateral bulging is an eventration and is not to be mistaken for a true hernia.

These protrusions are most frequently encountered in the lumbar region, as a rule, they are due to an arrest in development or to a congenital malformation comparable to the etiology of congenital diaphragmatic hernia or to muscular paralysis. This condition must be distinguished from lumbar hernia from lateral bulging of the abdominal wall without loss of muscle substance from epigastric protrusion in children and from local bulgings in the inguinal region in adults.



Fig. 109—Hernia in the right linea semilunaris in a man aged seventy nine years. There is also a direct inguinal hernia on the left side.

### Etiology

**Spontaneous**—The most frequent causes of spontaneous lateral ventral hernia are multiple pregnancies, obesity, marked emaciation after obesity, ascites, maldevelopment of the abdominal wall and muscular paralysis. Acute anterior poliomyelitis is probably one of the most common causes, especially in children (Baracz, Blauel). These hernias usually occur in middle life and the sexes are equally affected. Bartholémy was able to collect 23 cases in the literature of these, all occurred in adults and all were first noticed following a sudden strain.

Cooper wrote that lateral ventral hernias escape through one of the tiny openings for the blood vessels. This opinion was shared by Makrocki, Reignier and some of the early writers. Ferrand, Thévenot and Gabourd believed that a weak spot exists where the deep epigastric artery pierces the

fascia at the semilunar fold of Douglas. Bartholmey denied that the hernia escapes through one of the vascular foramina, and agreed with Malhière, who, in 1877, stated that the cause of these hernias is due to the arrangement of the layers of fascia in relation to the rectus muscle. In some cases the fascia is loosely attached to the muscle, and then there may be a diverticulum or pocket opening downward or inward, through which a hernia may occur following a sudden strain when the body is bent forward. When the erect position is assumed, the mass is caught in the diverticulum. There is also danger of strangulation when the site is distensible and has a very narrow peritoneal opening.

Ochlecker observed a number of cases in soldiers where a unilateral partial paralysis of the abdominal wall had been caused by the severing of intercostal nerves. The condition of pseudohernia may be recognized by having the patient increase his intraabdominal tension, and by testing the local sensibility.

### Symptoms and Diagnosis

The symptoms of small ventral hernias are often obscure and diagnosis is difficult. This is especially true of hernias in the linea semilunaris, which often do not entirely penetrate the abdominal wall, and are known as "interstitial hernias."

In certain instances diagnosis is possible only after an exploratory laparotomy. Postoperative ventral hernias offer no difficulties in diagnosis, the symptoms are those common to all hernias, and the tumor may reach large proportions. The seat of the former operation is discernible on the surface of the hernia.

**Functional Symptoms**—The functional or subjective symptoms resemble those of large hernias in the linea alba. Acute attacks of pain with gastrointestinal symptoms, colic constipation and partial obstruction are the rule. They are aggravated by coughing, pressure, and physical exertion.

**Objective Signs**—The signs of small ventral hernia are often indefinite, especially if the patient is obese and it is difficult to palpate the tumor. A careful examination will almost always disclose a localized point of tenderness, which is best elicited with the patient in the erect position. An impulse on coughing may be felt over the painful spot. Sometimes the tumor can be seen in profile with the patient standing. The small interstitial hernias in the linea semilunaris may give only a slight fullness or bulging on the affected side.

When the hernia is large and reducible, diagnosis is simple. If it is irreducible, often the exact position of the opening can be determined only by operation. The history of a previous operation or the presence of a scar over the mass will aid in establishing diagnosis. These large hernias are held in at the neck by a firm ring of fascia. Beyond the confines of this constriction, the hernia has a tendency to spread out in the shape of a mushroom and burrow outward beneath the subcutaneous tissues. The usual direction of greatest enlargement is downward.

While hernias in the linea semilunaris are rare strangulation is comparatively frequent. If the hernia is small and interstitial diagnosis is difficult or impossible without an incision over the suspected tumor or an exploratory laparotomy. Bryant reported the case of a man who had two previous attacks one diagnosed as appendicitis the other as stone in the bladder.

### Differential Diagnosis

The following conditions are to be thought of when examining for ventral hernia: diseases of the stomach, intestines and gallbladder; inflammation and tumors of the abdominal wall. The foci of infection in tuberculous peritonitis may be localized behind the rectus muscle and may simulate an irreducible hernia. The symptoms of cholecystitis and ureteral colic have been mistaken for those of strangulated ventral hernia. In rare instances small strangulated ventral hernia may be mistaken for intestinal obstruction. Lumbar hernia must not be confused with lateral ventral hernia. The former will appear behind the posterior border of the external oblique and will come through the triangle of Gynfellet Lesshaft or the triangle of Petit.

### Prognosis

Spontaneous hernios in the linea semilunaris are usually small. They do not produce marked symptoms and do not strangulate as frequently as hernias in the linea alba.

Traumatic ventral hernias have no tendency to spontaneous cure. On the other hand they progressively increase in size and are almost impossible to control with a truss on account of the large hernial ring. For this some reason strangulation is uncommon. The large hernias are frequently irreducible on account of the rapid growth of fat and omentum within the sac. Intrascaculor adhesions form early both between the contents and between the omentum and the sac walls. The skin over the fundus of the hernia is often the site of irritation and ulceration. The sac occasionally ruptures making the prognosis grave. Patients with large irreducible hernias often become confirmed invalids unless relieved by operation.

The outlook for cure by operation depends on the size of the hernia. The spontaneous hernias in the linea semilunaris and the small incisional hernias respond favorably with a low percentage of recurrence. For massive ventral hernia operation also offers the best chance of cure and relief from invalidism just as it does in voluminous umbilical hernia.

**Prevention of Hernia Following Laparotomy**—The prevention of hernia following abdominal operations depends largely upon the incision employed, the method of closing the wound and absolute asepsis. The incision for any procedure should be made so as to damage as little as possible the important structures of the abdominal wall: the motor nerves, muscles, fascia and blood vessels.

The motor nerves that supply the lateral abdominal wall are branches of the fifth and sixth lower intercostal nerves which run nearly transversely

forward after leaving the intercostal spaces and lie between the transversalis and internal oblique muscles. After giving off branches to these muscles as well as to the external oblique the nerves finally perforate the posterior sheath of the rectus muscle and terminate in the muscle. For this reason abdominal incisions should be made as near the linea alba as possible but when it is necessary to enter the abdomen through the lateral abdominal wall the incision should run parallel to the motor nerves in order to avoid muscular paralysis which will occur if these nerves are severed. Division of the nerves favors not only the occurrence of hernia but also a lateral bulging of the abdominal wall for which there is no operative relief.

A lateral transverse incision should be used when possible. In long incisions through the external and internal oblique and transversalis muscles whose fibers run at different angles it is impossible to avoid cutting some of the fibers and the incision should be planned so as to sacrifice the minimum amount of muscle and to preserve the motor nerves. Whenever possible it should be made through the rectus muscle rather than in the linea alba or linea semilunaris. Tinker has shown that the muscle splitting or the rectus retraction incisions give the lowest percentage of hernias. Assmy found from experimental studies that muscle atrophy always occurs when the motor nerve supply is severed. Rouffart collected from the literature 1506 cases in which the lateral transverse abdominal incision was used in the lower abdomen. Hernia developed in only 0.33 per cent of the cases.

It must be remembered that two short incisions heal quicker and more firmly than one long incision and strong retraction is always to be avoided. The fascia is the strongest structure in the abdominal wall and it is very essential to close it properly. The fascia is frequently under tension and unites more slowly than muscle tissue for this reason a simple approximation of the edges is not sufficient but it is necessary to overlap each layer separately. When closure under tension is unavoidable the patient's shoulders should be kept in a semi-reclining position and the knees elevated on pillows for a week after operation. Because fascia is always slow in uniting the patient should be kept in bed at least one week if the closure of the wound has been difficult.

The deep epigastric artery is the most important one to be encountered and should be preserved whenever possible on account of its branches to the muscles of the lower abdomen. All hemorrhage should be carefully checked before closing the wound as hematomas are liable to form and cause post-operative hernia.

The importance of using silk or cotton suture material in all abdominal wound closures cannot be overemphasized. Tension or stay sutures are of service to prevent strain on the fascial sutures. A gain in weight after operation especially in obese subjects increases the intraabdominal tension and weakens the abdominal wall. The use of an elastic belt after operations checks the tendency to rapid accumulation of fat. (See chapter on umbilical hernia.)

Meteorism or gas pains predispose to a weakening of the abdominal closure by producing tension on the sutures. This complication can be minimized by

proper preoperative treatment and postoperative measures. I have found that it is prevented by changing the patient's position frequently and by using the Wangenstein continuous suction tube along with a small rectal tube or catheter. In case of strangulation this should be employed before operation. Prostigmin is also helpful and early rising if the hernia is small.

### Treatment

The operation is indicated in all cases of ventral hernia except in those patients whose general condition does not warrant the undertaking of any operative procedure or when there is no prospect of reducing the hernia and closing the opening.

Spontaneous hernias in the lower semilunaris and small traumatic hernias are easily cured by the radical operation and the percentage of recurrence is very low. The massive ventral hernias are always serious because of the difficulties of treatment. In obese subjects the amount of fat in the hernia should be reduced and intraabdominal tension lessened by appropriate preoperative diet and exercise as described under umbilical hernia.

**Mechanical Treatment**—Small ventral hernias can be controlled more or less satisfactorily by a truss but there is little prospect of a cure by this means. If the hernia is in the median or parmedian line an umbilical truss can be used, while if the protrusion is in the appendix or inguinal region an inguinal truss can be applied. Because of the large hernial opening and the accumulation of fat in the abdominal wall massive ventral hernias can seldom be held by a truss. Although a belt will give the patient some comfort it will not keep the hernia from increasing in size. For these voluminous hernias the belt must be made of heavy canvas elastic material which is sometimes used to save trouble in fitting is seldom satisfactory.

**Taxis**—Taxis is dangerous and is never to be employed in this variety of strangulated hernia on account of the danger of reduction *en masse*.

**Radical Operation**—The operative treatment for ventral hernia is similar to that already described in more detail for umbilical hernia. Ventral hernias in the median and parmedian lines are exposed by a vertical or transverse incision over the tumor. In postoperative hernia the scar is excised and the sac opened to one side of the site of the former operation so as to avoid adhesions that may have been formed between the sac contents and the peritoneum. In ventral hernia as well as in umbilical the adhesions are always most dense over the fundus. Adherent omentum should be ligated in small sections excised and all bleeding points carefully secured. The hernial ring is freely exposed and the fat stripped away from the fascia for a distance of 2 inches (5 cm) from the edge of the opening. The fascia is now incised at either side and the retracted muscle edges are secured and two transverse flaps formed one above and one below. The sac is excised if the hernia is small and there are no adhesions; if it is large and adherent it is inverted and folded on itself in the shape of a pad to help reinforce the closure. The posterior layer of fascia together with the peritoneum if the latter has been opened are brought

together and sutured, the freshened muscle edges are approximated and sutured and finally the transverse fascial flaps are overlapped and stitched with silk or cotton. If the opening is oval or round the best results are secured by overlapping the flaps from above downward but if the wound is elliptical and the patient not obese it is usually advisable to overlap the flaps from side to side as suggested by Mihornei. He overlaps the tissues longitudinally with interrupted silk sutures. The fascia of the posterior rectus sheath is sutured then the rectus muscles are stitched the anterior rectus sheath is overlapped and sutured fascial strips are passed transversely across the wound and sutured to the anterior rectus fascia near the linea semilunaris to relieve tension on the wound. The subcutaneous tissues and skin wound are closed in the usual manner.

In large hernial openings when it is difficult to bring the fascial flaps together it can sometimes be accomplished by separating the flap for some distance from the underlying muscle. If the flaps are brought together under considerable tension or if the hernial opening is in the upper abdomen and the movement of the lower ribs is interfered with there is a strong probability that the hernia will recur unless the line of suture is reinforced by a flap turned up from the sheath of the rectus or by a transplant of fascia lata similar to that used to close a gap when the edges of the wound cannot be approximated. Fascia lata taken from the lower part of the abdominal band of the thigh makes the best graft. The transplant should be a little larger than the defect to be covered and it is placed directly over the hernial sac and sutured to the edge of the opening with silk or cotton.

Hernias in the upper midabdomen are the most difficult because the releasing incisions have to be carried on to the costal arch. Interrupted fine silk or cotton sutures are used for the fascial closure. It is sometimes advisable to reinforce the line of closure by through and through silkworm gut sutures, or with tension sutures tied over wooden or pearl buttons. The sutures may be left in as long as twenty days in large hernioplasties.

**Hernia Following Appendectomy**—In hernia following appendectomy an elliptical incision should be used if the sac is thin and adherent to the skin if the sac is not adherent a vertical incision saves time. The skin incision can be made through the old scar or directly over the hernia and extended down through the fat to the neck of the sac. Nothing is gained by opening the fundus the adhesions here often make it difficult or impossible to reach the neck of the sac and time is saved by beginning the dissection at the neck and working inward. When there are no symptoms of obstruction it is usually advisable to leave the sac it is tedious to remove it and new adhesions are liable to form causing more trouble than the old ones. Besides the sac can be inverted or folded on itself and used to reinforce the closure of the opening. If the sac is not removed it is important to sew up any holes in it to avoid the chance of strangulation through one of them.

I have found that the simplest method of exposing the hernial opening is to invert the sac on one or two fingers and feel the sharp fascial edge which is usually most distinct on the outer side of the hernia near the inguinal ligament.

With the finger as a guide, the incision is made directly down to the fascia. Once the aponeurosis is located it is easy to continue the incision and expose the fascia entirely around the neck of the sac. It is important to extend the dissection for some distance from the hernial opening in order to recognize the muscle and fascia layers and to secure flaps that can be united without undue tension.

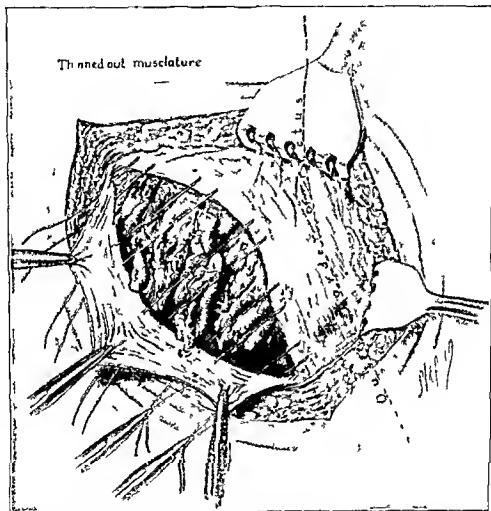


Fig. 170.—Operation for lateral ventral hernia following appendectomy. After dealing with the hernia the abdominal wall should be reconstructed as well as possible. When the musculature and fasciae are very thin they are used as a single flap which is drawn down and sutured to the outer fascial edge of the wound (the external oblique aponeurosis or the inguinal ligament).

The abdominal wall should be reconstructed as well as possible. The transversalis and internal oblique muscles and fascia have become so thin that they cannot be separated and they should be used as a single flap, which is drawn down and sutured beneath the outer fascial edge of the wound, this edge being the external oblique aponeurosis or the inguinal ligament. The second flap, which is secured from the aponeurosis of the external oblique, is drawn down and lapped under the inguinal ligament and over the first flap. Sometimes the musculature and fascia are so thin that only one flap can be



obtained (Fig 170) A simple approximation of the edges of the fascia is not sufficient, they must be overlapped for a distance of one or two inches (2.5 or 5 cm) to give the maximum of strength to the abdominal wall (Fig 171) Finally, tension sutures must be inserted to take the strain off the fascial stitches When recurrence takes place the hernia first appears at a point where the fascial closure is defective This weak spot may be due to insufficient lapping of the fascial edges to closure under too much tension or to infection

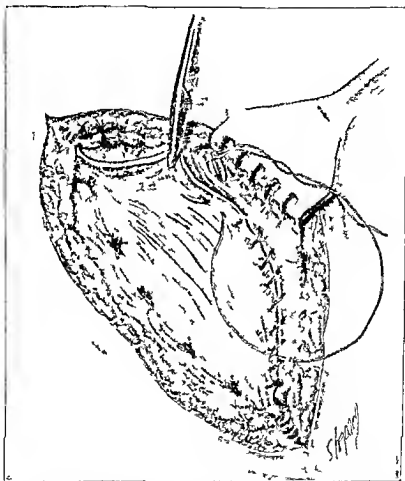


FIG. 171—Operation for lateral ventral hernia following appendectomy. A simple approximation of the edges of the fascia is not sufficient to prevent recurrence. After overlapping the flaps for a distance of 1 to 2 inches (2.5 to 5 cm) the free edge of the outer flap is fastened to the anterior surface of the aponeurosis of the inner flap by a continuous suture or preferably interrupted sutures of fine silk or cotton. Finally the subcutaneous tissues and skin are closed and tension sutures are inserted to take the strain off the deep stitches.

Gallie was forced to abandon his filigree method of filling fascial defects as recurrences developed through the chinks between the fascial sutures. As a result he decided on using a broad patch of fascia designed much like a many-tailed bandage.

In midline hernias Power made releasing incisions in the recti sheaths on each side of the hernial opening. This permits the wound to be closed without tension. No ill effects resulted from the aperture left in the recti sheaths and he reported 13 patients free from recurrence over a period of six years. Rothschild closes the opening by taking flaps that are raised and hinged along the medial border of the rectus sheath and sutured over the hernial opening after the edges of the latter have been stitched to the remaining portion of the anterior sheath of the rectus muscle.

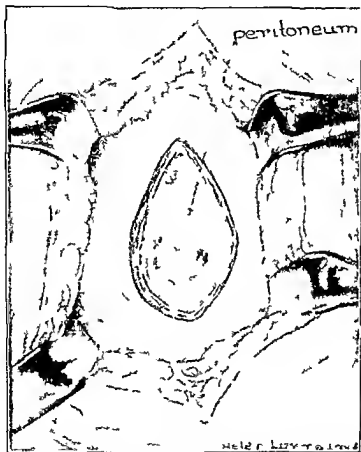


Fig. 172—The fascial patch operation. The peritoneum is freed from the abdominal muscles for some distance from the femur by undermining.

**Lipectomy**—Lipectomy should be combined with the operation for ventral hernia in obese subjects with pendulous abdomens. The technique is the same as that for lipectomy and umbilical herniorrhaphy.

**Wangensteen's Operation**—This operation is especially suitable for massive hernias that cannot be closed by the usual operations. Wangenstein has successfully repaired difficult and recurrent ventral hernias as well as large defects of the abdominal wall by using the iliothoracic tract of fascia lata pedicled on the tensor fasciae femoris muscle as a graft according to the author's special technique. This method is especially adapted to dealing with large defects of the abdominal wall situated below the umbilicus.

Maclean closed a large hernial ring by combined vertical and transverse suturing. First one lateral flap is sewed to the posterior border of the opposite rectus sheath, then the lower flap is sewed to the firm edge under the upper flap, and finally the upper flap is brought down and stitched over the lower flap as a reinforcement measure.

Cattell closed the wound with four or five layers of fascial sutures, Henry suggested rolling up the fascia as it is sutured. Hinton used the extraperitoneal operation for massive incisional hernias and Guthrie, Olson and Masson stated that when the size of the hernial opening makes it impossible to overlap the edges of the wound the defect can be darned in with fascial strips as a stocking is darned. Trippoli inverted the unopened sac and overlapped the fascia.



Fig. 173—The fascial patch operation. The fascial patch is tucked into the space previously undermined and fixed with interrupted sutures. The muscle edges are then brought together and overlapped or imbricated.

**Fascial Patch in Ventral Hernia**—After the parietal peritoneum is exposed it is not opened but is freed from the abdominal muscles for 1 to 3 inches (2.5 to 7.5 cm) from the edges of the hernia by undermining. The fascia patch is taken from the lower or middle third of the lateral aspect of the

thigh. The size and shape should be cut to fit the hernial defect. The fascial patch is fixed with interrupted sutures of silk or cotton into the space previously undermined. The muscle edges are brought together by interrupted sutures of silk or cotton. The edges should be overlapped or imbricated whenever possible. It is important to leave the peritoneum intact to prevent abdominal adhesions. If the sac has been opened omentum should be stitched beneath the patch to prevent the formation of adhesions.

**The Cutis Graft**—The cutis graft has proved an effective adjunct in the treatment of large and recurrent hernia in the hands of Cannaday, Swenson and Harlins and others.

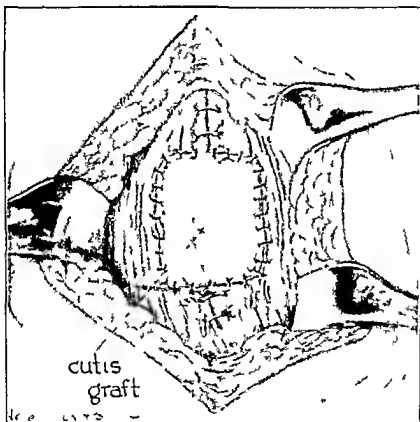


Fig. 174.—The cutis graft patch. The muscles and fascia are closed in the usual manner. The cutis graft patch is applied and fixed in position with interrupted sutures.

The muscles and fascia are closed in the usual manner. Cannaday prefers to take the graft from the antero-external surface of the upper third of the thigh. Other skin areas are equally suitable for the cutis graft.

After thorough skin sterilization the epidermal layer of the skin is cut away in a thin sheet with a skin graft razor. Then the dermis is cut to a suitable size and shape and removed from its bed.

The cutis graft is placed over the sutured wound and fixed in position with interrupted cotton sutures. It is important to obliterate all dead spaces over the graft as the wound is closed.

For large hernias it is advisable first to close the hernial opening with fascia sutures and then to apply the fascial patch. This method is favored by Morse and Barb, Fernandez, and others.

**Strangulation**—Spontaneous hernias in the linea semilunaris are almost always small and of the interstitial type. They are rare, but the percentage of strangulation is high. Abdominal rigidity, with a localized point of tenderness in the region of the fold of Douglas, if associated with the symptoms of intestinal obstruction, calls for immediate operation. The incision should be made directly over the point of tenderness. When diagnosis is impossible and there is no painful point, a median incision should be made and all the possible sites of hernial strangulation should be examined.

Strangulation of traumatic or postoperative ventral hernia is not common. When it occurs it is usually intrasaccular. An irreducible ventral hernia with symptoms of obstruction requires immediate operation.

**Prevention of Postoperative Complications**—The preoperative treatment of the massive irreducible ventral hernias is very important, in order to minimize the danger of pulmonary edema, pneumonia, disturbances in the cardiovascular system, and acute dilatation of the stomach. (See umbilical hernia.)

**Recurrence**—Recurrence after operation is high. Hook stated that recurrences after operation for incisional hernia average 14 to 40 per cent. Branch followed up 204 patients after operation for incisional hernia over a period of two years. There was recurrence in 40 cases or 19.6 per cent. Ninety-six cases could not be traced.

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## CHAPTER XXIII

### EPIGASTRIC HERNIA

While *hernia in the linea alba* is the correct term for these hernias, it is not in general use among surgeons, therefore, it has been thought advisable to call them epigastric hernia. While rare, hernia in the linea alba does occur below the umbilicus, in which case it is a hypogastric hernia. Hernia in the linea alba nearly always appears above the umbilicus, hence the term epigastric hernia, because in olden times it was believed to be a hernia of the stomach. One per cent of all hernias are epigastric.

**Synonyms**—Epigastric hernia, gastrocele, Sepoy's hernia, hypogastric hernia, hernia ventralis mediana, hernia in the linea alba.

**Definition**—A hernia in the linea alba is a protrusion of abdominal viscera through an opening in the linea alba. It can be epigastric or hypogastric.

**Hernial Contents**—A mass of fat or a peritoneal lipoma is often the sole content of the small hernias. Léveillé, in 1812, remarked that these hernias usually consisted of a small lipomatous mass, rarely of omentum. In large hernias, the sac usually contains omentum, sometimes transverse colon and small intestine, and rarely ascending or descending colon, stomach, gallbladder or other viscera. These large hernias usually have a pedicle, and the neck of the sac is seldom adherent to the edge of the fibrous ring. As in the umbilical variety, the omentum in large hernias in the linea alba becomes adherent to the sac wall early, and for this reason many of these hernias are irreducible. Pollock found only a protrusion of peritoneal fat and no sac in 19 out of 45 patients. Part of the stomach wall has been found in the sac, but it is rare. Strangulation very seldom occurs.

The following table gives a good idea of the relative frequency of the most common hernial contents.

	TOTAL CASES	FAT ALONE	PERITONEAL SAC ALONE	OMENTUM ONLY	INTESTINE
Thomson	38	6	2	26	4
Ploeger	86	39	11	31	5

#### Diastasis of the Recti

**In Children**—In young children sometimes the linea alba is very thin and abnormally wide, so that there is a separation of the recti muscles and a bulging is noticed when the child cries. The protrusion is usually above the umbilicus, when it is known as a supraumbilical eventration, or it may sometimes appear just below the navel.

**In Adults**—In adults the diastasis may occur anywhere in the linea alba. It usually appears below the umbilicus, and in rare instances it may extend from the umbilicus to the pubes. It is most common in women, often being caused by repeated pregnancies.



Large eventrations may reach below the pubes and contain all the movable abdominal viscera, and the uterus during pregnancy. The margins of the separated recti can be felt on each side of the tumor. The symptoms are those accompanying any large hernia—pain, constipation, and marked disability. Mechanical treatment is usually unsatisfactory. The radical operation described for ventral hernia is the treatment of choice, and it should be undertaken early, on account of the atrophy of the muscles in the neglected cases.

**Suprapubic Hernia in the Linea Alba**—Voeckler, in 1912 called attention to a rare form of hernia in the linea alba to which he applied the term, *suprapubic hernia*. He reported a case occurring in a woman, forty-four years old, who complained of a localized point of tenderness and a tumor the size of a pigeon's egg just above the symphysis pubis in the midline. Symptoms of strangulation developed and operation disclosed a hernia, the size of a pear, extending over the symphysis pubis into the ilium majus. Gangrenous intestine was resected, the sac excised and the peritoneum fasciæ and pyramidalis muscles were sutured together in separate layers, the patient made an uneventful recovery. Voekler was able to collect 5 additional cases in the literature.

### Historical

In ancient times no distinction was made between umbilical hernia, ventral hernia, and hernia in the linea alba. In the fourteenth century Guy de Chauliac (in 1572) attempted to distinguish those hernia coming through outside the umbilicus from those protruding through the umbilical opening but his efforts received scant notice and the surgeons of that time refused to consider his revolutionary ideas. Over a hundred years later LaChrasse in 1721, maintained that a hernia could come through any part of the abdominal wall. Petit, in 1737 described fatty hernia or lipoma of the linea alba. He believed it often came through the aperture for the umbilical vein and not through the umbilical ring. He presented his views to the Royal Academy of Surgery in Paris. They solemnly disapproved of his opinions and decreed this group must remain hernia of the stomach though not one of them had ever found the stomach in a hernia in the linea alba. De Garengot in 1743 described the weakest spot in the upper abdomen as the *linea alba* just below the xiphoid cartilage. One account of the marked gastrointestinal symptoms he believed part of the stomach must find its way into the hernia. Hoin and Pipelet agreed with De Garengot, but Gunz in 1744 firmly maintained that the stomach was rarely or never present and his views were gradually accepted.

Winslow, in 1743 was the first to describe the *linea alba* accurately. Arnaud deRonsil in 1749 described hernia in the linea alba as superficial ventral hernia that did not come through the natural openings. Morgagni in 1760 published a complete description of supraumbilical hernia. In 1785 Richter called the master hernia surgeon by Malgaigne maintained that supraumbilical hernia consisted of a lipoma, the transverse colon with its mesentery, and

not stomach as De Garengot and others believed. Lawrence, in 1806, classed hernia of the linea alba with ventral hernia. Laennec, in 1807, described an extraperitoneal strangulated hernia reduced *en masse*; autopsy disclosed an opening in the linea alba above the umbilicus. Pelletan, in 1810, was the first to describe accurately fatty hernia or lipomas, with and without a peritoneal sac. He aptly compared the formation of the sac to the sac of inguinal hernia formed by the descent of the testis.

Léveillé, in 1812, was the first to apply the term "epigastric" to those hernias occurring in the median line above the umbilicus. Cloquet, in 1817, described at length the anatomy of lipomas or fatty hernia with and without peritoneal sacs through the natural openings for the blood vessels. Searpa, in 1819, discussed the anatomy and emphasized the rarity of hernia in the linea alba below the umbilicus, due to the strength lent to these structures by the close approximation of the rectus muscles, as compared to the rectus muscle weakness above the umbilicus in the midline. Cooper, in 1827, wrote on fatty hernia in the linea alba, and reported cases, including one of strangulated hernia.

Malgaigne, in 1841, believed that epigastric and linea alba hernias were congenital and hereditary, because of their frequent presence along with other types of hernia. Cruveilhier, in 1845, stated that a small lipoma insinuates itself along the side of a blood vessel, and gradually dilates the aperture until the epigastric hernia finally protrudes. Nélaton, in 1857, stressed the importance of differentiating between simple lipomas and fatty hernia with a peritoneal sac. Terrier, in 1869, described four varieties of epigastric hernia and their surgical treatment. Macready, in 1893, still called it ventral hernia of the linea alba. Moscheowitz, in 1914, published a paper on the pathology and treatment of epigastric hernia. Janssen, in 1932, reported 76 cases of epigastric hernia treated by operation, of these, 62 were preperitoneal lipomas, and 14 had peritoneal sacs. Velarde Pérez Fontana, in 1934, published the most complete monograph on epigastric hernia that has appeared in surgical literature.

Pollock, in 1936, considered the anatomy and etiology of epigastric hernia, Pemberton and Curry discussed the symptomatology, and Popper narrated the operative treatment. Lake, in 1938, wrote on the diagnosis. Monteiro, in 1941, pointed out the frequency of peptic ulcer as a complication. Catalano, in 1943, reviewed the literature on strangulated epigastric hernia. Peters and Nesselrade, in 1945, wrote on the symptom and diagnosis.

### Anatomy

**Linea Alba.**—The linea alba extends from the ensiform cartilage to the symphysis pubis. It is situated between the inner borders of the recti muscles, and is formed by the blending of the aponeuroses of the external and internal oblique and the transversalis muscles. It is narrow after the first 1 or 2 inches (2.5 to 5 cm.) below the umbilicus, where the recti muscles are well developed and close together. Above the umbilicus the muscles become thinner and tend to separate as they pass upward to their insertions in the costal cartilages of the fifth, sixth and seventh ribs. Only a few fibers go to the

ensiform cartilage. As the linea alba approaches the ensiform cartilage it is often  $\frac{1}{2}$  to 1 inch (12.5 to 25 cm) wide, and is connected with the lineae semilunares by the lineae transversae which are narrow tendinous bands intersecting the recti muscles. The falciform ligament of the liver is attached to the diaphragm and to the linea alba usually a little to the right of the midline.

There are minute openings in the linea alba usually five on each side for the passage of vessels and nerves. When the vessels pierce the transversalis fascia they carry a prolongation of this fascia with them and this opening is a weak point in the linea alba. With an increase of intraabdominal pressure the first tissue to be forced through is the preperitoneal fat of the falciform ligament.

**Hernial Orifice**—When hernia in the linea alba does not involve the falciform ligament the opening is usually to the left of the median line or it may rarely be in the center. On the other hand if the hernia contains only preperitoneal fat of the falciform ligament the opening is almost always just to the right of the median line. It is most often found within the first 3 inches (7.5 cm) above the umbilicus, less frequently it is within the first 2 inches (5 cm) below the umbilicus. These hernias are rare in the upper or lower portions of the linea alba. Occasionally there may be more than one opening. Berger saw 4 in one patient and Bambridge observed a patient with umbilical hernia who also had four openings in the linea alba. I have seen three openings below the umbilicus in an elderly woman.

**Size of the Hernial Opening**—The hernial opening is ordinarily no larger than the tip of the little finger and there is not much tendency for the small hernias to increase in size because the fascia is strong and unyielding. Large hernias in the linea alba are almost always found just above the umbilicus.

**Hernial Sac**—Small hernias in the linea alba are usually without a sac.

When a sac exists it may be very small barely protruding through the opening in the fascia and often it is not discovered until the preperitoneal lipoma is excised.

**Varieties of Hernia in the Linea Alba**—Terrier proposed classifying hernias in the linea alba as follows:

- 1 Lipomas without a peritoneal sac
- 2 Lipomas with a peritoneal sac containing omentum
- 3 Omental hernia without a lipoma
- 4 Peritoneal sacs containing intestine and omentum

### Etiology

**Frequency**—Hernia in the linea alba is more frequent than statistics indicate. Patients with this variety of hernia usually have no symptoms and doubtless many of them never seek medical advice. In the examination of recruits Hall stated that these hernias were found by the dozen that they were so common no record was made of them except when they were accompanied by symptoms. In 28,348 hernias collected by Serba 223 or 0.8 per cent were in the linea alba.

In 15,271 clinical cases collected from the literature by Friedrich, the frequency of hernia in the linea alba was as follows

	PATIENTS EXAMINED	CASES OF HERNIA IN LINEA ALBA	PER CENT
Males	12,724	52	41
Females	2,557	2	08

The older statistics indicate that hernia in the linea alba constitutes about 1 per cent of all hernias, and that it occurs five times more often in men than in women. Berger, in a series of 10,000 hernia patients, found 137 epigastric. Of these patients, 120 were males and 17 females. Macready, in 19,341 cases of hernia, found 38 were epigastric. Popper observed that 17 per cent of hernias that came to operation were in the linea alba, and in 13 of the latter one was strangulated.

These hernias develop earlier in men than in women and are most common between the twentieth and thirtieth years. In a series of 71 cases reported by Nageli, 94.4 per cent were in men, and 5.6 per cent in women. In the women, 33.8 per cent occurred between the twentieth and thirtieth years and 22.5 per cent between the thirtieth and fortieth years. In young children the sexes are affected equally, but the condition is rare. These hernias are often associated with hernias of other regions, in both children and adults.

### Predisposing Causes

**1 Congenital**—There is probably no congenital predisposition to hernia in the linea alba. Congenital weakness of the linea alba, malformation or arrested development of the muscles or fascia may be a favoring factor. Cooper saw an infant with three hernias in the linea alba that were present at birth, LePage and Walter each observed a similar case. I saw an infant, one year old, with an epigastric hernia of congenital origin that measured 1 inch (2.5 cm) in diameter.

**2 Properitoneal Lipoma**—The importance of properitoneal lipoma in the etiology of hernia in the linea alba was recognized by many of the early writers, including Scarpa, Cooper, Cloquet, Velpeau, and others. It is probable that a small lobule of fat, aided by intraabdominal pressure, insinuates itself into an interstice in the fascia, and as it increases in size, it acts as a wedge, gradually spreading the elliptical opening. As this fatty plug advances, it draws after it a funnel-shaped process of parietal peritoneum, which is usually empty and is not discovered until the lipoma is cut away.

Many writers believe that these hernias escape through an opening in the fascia alongside the blood vessel. This point was emphasized by Cooper, who stated that "these holes are sometimes larger than is sufficient to allow the vessels to pass, and protrusions of viscera readily occur through them." I have never failed to find a well defined vessel coming through the opening in the fascia, accompanied by a lipoma which is continuous with the fat of the falciform ligament. Villard maintained that epigastric hernias are sliding hernias of the round ligament of the liver.

**3 Exciting Causes**—Other factors that favor the development of hernia in the linea alba are strains, laborious occupations, and traumatic injuries. These hernias usually occur in men who do heavy manual labor, in women, pregnancy is the principal exciting cause. Obesity and rapid emaciation have their influence in both sexes.

### Symptoms and Diagnosis

Examinations of recruits for the Army and the Navy show that hernia in the linea alba is more frequent than statistics have indicated. It is a subject that has always been overlooked more than neglected. The tumor is almost always small, there are no symptoms in 75 per cent of the cases and diagnosis depends on a thorough and painstaking examination.

Small hernias in the linea alba may also give rise to very severe symptoms. Unless the possibility of hernia is always borne in mind, diagnosis may be difficult on account of the prominence of the gastrointestinal symptoms.

**Functional Symptoms**—The subjective symptoms include colicky pain, nausea, sour stomach, distress after eating, occasional vomiting, constipation, and a dragging sensation in the abdomen which is due to traction on the parietal peritoneum or on the falciform ligament. Villard believed that the unusual functional symptoms may also be due to traction exerted by the round ligament on the liver.

The pain is most severe in the epigastrium and sometimes extends to the thorax, the lateral abdominal wall, lumbar region, bladder, and rectum. Blumer had a patient who complained of pain radiating to the shoulders and arms, and Aaron's patient had paroxysms of pain after eating which sometimes extended around the body and down the thighs.

Patients sometimes secure temporary relief from the pain by vomiting or taking a small quantity of liquid food or by lying on the back. The pain is aggravated by coughing, physical exercise and by eating solid food.

**Objective Signs**—The objective signs are often indefinite. A small tumor, sometimes no larger than the tip of the little finger, should be looked for just above the umbilicus to the left of the median line or it may be found in rare instances, in the center or just to the right of the median line. While it is unusual the hernia occasionally appears below the umbilicus and the suprapubic variety makes its appearance just above the symphysis pubis in the median line.

Owing to the severity of the functional symptoms which overshadow the objective signs, the existence of a small tumor may not be thought of, and it may be discovered quite accidentally during a close examination of the abdomen. The relief of symptoms that follow the reduction of this little tumor may give the first clue to diagnosis. The most characteristic objective sign is localized pain and tenderness on pressure over the hernia. In obese subjects a small hernia may be impalpable, but a definite point of tenderness can always be located. If the hernia is reducible it disappears when the patient is in the reclining position, and the sharp edge of the ring can be felt by making pressure on the tumor and following it with the finger through the opening, as it is reduced.

Small openings in the fascia that cannot be felt when the hernia is reduced can be detected by this maneuver. Light pressure on the hernia is sometimes followed by instantaneous belching. Hall has termed this sign the electric bell retraction."

Coley (W. B.) has called attention to the difficulty of diagnosing hernia in the linea alba especially in children. He stated that the protrusion of a small tumor through a slit in the aponeurosis can be detected only by having the patient cough repeatedly. Ordinarily the plug of fat slips back beneath the fascia and nothing can be felt on palpation.

As early as 1748 Arnaud called attention to the importance of examining the patient in the erect position. A very small hernia can often be seen in profile when the patient coughs or strains.

**Latten's Sign**—This sign is also best elicited with the patient in the erect position and with shoulders thrown back or it can sometimes be detected in the recumbent posture. If the examiner will place his hand on the abdomen over the suspected hernia and request the patient to cough he will feel a vibration or tremor such as would be experienced if liquid or a handful of peas were thrown against his hand. Latten believed this sensation is due to the presence in the sac of intestine containing fluid and to small lobules of fat in the omentum which are forced outward by the impulse of coughing.

**Pain**—The reflex gastric pain is probably due to traction on the great omentum which is attached to the greater curvature of the stomach and during the attacks a piece of the omentum is caught between the sharp edges of the slit in the fascia. When the omentum slips back into the abdominal cavity, the pain disappears. Traction on the falciform ligament of the liver is responsible for the gastric pain in those small hernias in which this ligament or the fat between its layers is the sole content of the hernia. Gussenbauer explains the severe symptoms that occur in certain cases as being due to pressure on one or more of the nerve filaments of the five lower intercostal nerves which pass through openings in the linea alba. These intercostal nerves anastomose with the phrenics in the diaphragm.

In about 25 per cent of epigastric hernias with symptoms there are changes in the gastric juice and in the physical signs of the stomach itself. The most frequent of these symptoms are hyperacidity, lessened motility, gastroparesis and dilatation. Alessandrini reported a case in which an epigastric hernia and a gastric ulcer existed in the same patient; the hernia did not become painful until the ulcer developed.

**Complications**—Irreducibility is infrequent. In 116 cases of hernia in the linea alba collected by Berger 12 were irreducible. Epiploitis sometimes occurs and may be mistaken for strangulation.

**Strangulation**—Strangulation of *hernia in the linea alba* is unusual and the symptoms do not differ from those in other varieties of hernia. Along with constipation and vomiting there is a sharp continuous pain in the upper abdomen with a tender irreducible mass in the linea alba that may be no larger than the end of a thumb or in rare instances it may be the size of a fetal head. The severity of the symptoms depends on the viscera that are strangulated.

The symptoms of omental strangulation are often indefinite and are liable to be mistaken for those associated with abscess of the abdominal wall. Strangulation may occur at any age. Fraser has reported a case in a woman 101 years old who was successfully operated on under local anesthesia. The sac contained omentum and transverse colon.

### Differential Diagnosis

Small hernias in the linea alba, especially the epigastric variety, must be distinguished from diseases of the upper abdomen.

**Gastric and Duodenal Ulcer**—Hernia in the linea alba has often been confused with gastric or duodenal ulcer and sometimes the two conditions exist at the same time. The presence of a tumor or a slitlike opening in the linea alba with or without the protrusion of a small mass on coughing will help to establish a diagnosis of hernia. In gastric ulcer there is a localized point of tenderness in the linea alba as is always found in hernia. In ulcer the symptoms come on at a certain interval after eating while in hernia the paroxysmal attacks have no relation to meals but usually follow physical exertion and the patient finds that the most relief is secured by assuming a doubled up position which relaxes the linea alba. In hernia relief is sometimes secured by lying on the back and in ulcer by lying on the right side. In 690 cases of gastric and duodenal ulcer reported by Mandl 14 patients had hernia in the linea alba (2.3 per cent). In another series of 40 patients operated on for hernia in the linea alba 15 had an ulcer of the stomach or duodenum (35 per cent).

**Cholelithiasis**—Hernia in the linea alba is sometimes mistaken for gall stone attacks. In hernia there will be an absence of jaundice, leukocytosis and pain over the gallbladder, all symptoms that are characteristic of gallstone colic.

**Other Conditions**—Other diseases that hernia in the linea alba has been mistaken for are: habitual epigastric protrusion in children, gastritis, gastralgia, carcinoma of the stomach or intestine, cholecystitis, colitis, appendicitis, nephrolithiasis, inguina pectoris, abscess or tumor in the abdominal wall and the gastric crises of tabes.

**Cancer of the Stomach and Epigastric Hernia**—Cases of carcinoma of the stomach and epigastric hernia in the same patient have been reported.

**Roentgen Ray Examination**—When the epigastric hernia is complicated by gastrointestinal symptoms even though they are mild a roentgen ray examination is important for diagnosis because of the frequent association of gastric and duodenal ulcer with this variety of hernia. Sometimes when the roentgen ray examination is negative it is advisable to do an exploratory laparotomy at the time of the hernioplasty.

### Prognosis

In children hernias in the linea alba tend to close spontaneously as the child grows older. This is especially true of small openings below the umbilicus. Above the umbilicus the fascia is thinner and the openings are usually larger. Seventy five per cent of the small reducible hernias produce no symp-

toms and do not incapacitate the patient. On the other hand, the remaining 25 per cent cause more severe symptoms than any other variety of the small hernias.

Strangulation is infrequent because these hernias almost always consist only of fat or omentum. The presence of intestine or stomach in the sac is very rare on account of the opening being located high up on the abdominal wall and the tendency of the intestines to gravitate downward, while the stomach occupies a relatively fixed position.

Operative treatment is always to be recommended for hernias in the linea alba which are increasing in size or producing symptoms. The operation for hernia alone is comparatively simple, almost free from danger, and the results are uniformly good both in adults and in children.

**Recurrence**—Recurrence following the operation for hernia of the linea alba is very slight with present day methods.

The prognosis concerning the relief of abdominal pain and other symptoms should always be guarded. In 12 patients operated on by Landenstein, 11 were free from symptoms five years after operation.

### Treatment

Operation or injection is the treatment of choice for hernia in the linea alba because the outlook for permanent cure is good, and the danger of the procedure is very slight.

**Mechanical Treatment**—Mechanical treatment is unsatisfactory on account of the pain and discomfort caused by the appliance, and the difficulty of holding the hernia. It has its place, however, in the treatment of very small hernias in young children when the chance of spontaneous closure of the opening is good. Strips of adhesive plaster should be applied in these cases in the same manner as described for the treatment of umbilical hernia. When the general condition of the patient does not justify an operation, and when there is little chance of returning the hernial contents to the abdominal cavity and successfully closing the opening, bandage and truss treatment should be employed. An umbilical frame truss can be used for small reducible hernias either above or below the navel.

**Radical Operation**—There are two types of operations for hernias in the linea alba: (1) intraperitoneal and (2) extraperitoneal.

*The intraperitoneal operation* is indicated for hernias that contain viscera, and it is necessary as a means of diagnosis in cases with obscure gastrointestinal, gallbladder, or appendix symptoms. The technique is similar to that already described for small umbilical hernia.

*The extraperitoneal operation* is usually sufficient for properitoneal lipomas and the small hernias. A small vertical or transverse incision is made over the mass and the skin and subcutaneous tissues are carefully divided down to the hernia. If the incision is made a little to the right of the hernia one can usually avoid opening the peritoneum. If the hernia consists of a properitoneal lipoma, the fat is carefully separated and the blood vessel located, usually on the



*right side of the mass* This vessel should be ligated as high as possible and the lipoma ligated also before excising it so there will be no secondary hemorrhage. After these stumps are pushed back into the opening, the fascia is closed by one or two sutures. If a sac is present either as a sole content of the hernia or if it is hidden by a peritoneal lipoma and exposed by traction it should be opened, the contents reduced and any adhesions separated.

The redundant portion of the sac should now be excised and the wound closed in layers. I believe there is less chance of recurrence in all hernias in the

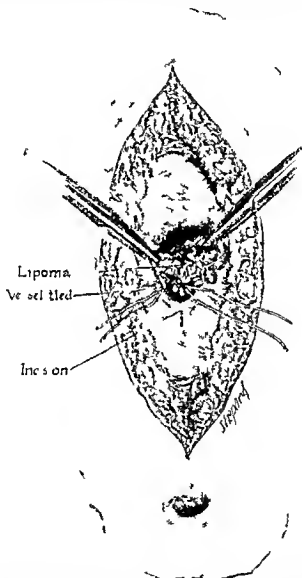


Fig. 15 Operation for hernia in the linea alba. A small vertical incision is made over the center of the mass. The skin and subcutaneous tissues are carefully divided down to the hernia. If the mass consists of a peritoneal lipoma, the fat is separated and the blood vessel located and ligated as high as possible. The lipoma is ligated before being excised so as to avoid secondary hemorrhage.

linea alba, whether they are simple properitoneal lipomas or hernias with sacs, if the fascial flaps are overlapped, according to the method described for umbilical hernia (Figs 175 and 176)



Fig 176—Operation for hernia in the linea alba. The fascia is closed by overlapping the flaps. The subcutaneous tissues and skin are closed in the usual manner without drainage.

Traumatic hernias in the linea alba should be treated by overlapping broad flaps of fascia, reinforced on each side by additional flaps of fascia from the anterior sheath of the rectus muscle. Free fascial transplants from the fascia lata of the thigh or fascia from other regions may be used to close any remaining gaps.

(Strangulation of hernia in the linea alba is rare. The treatment is the same as that for strangulated umbilical hernia.)

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## CHAPTER XXIV

### DIAPHRAGMATIC HERNIA

**Synonyms**—Phrenic hernia (Cooper), thoracic hernia, phrenocoele diaphragmatocele, upside down stomach

**Definition**—A diaphragmatic hernia is a protrusion of abdominal viscera through a normal or an abnormal opening in the diaphragm into the thorax

#### Historical

While diaphragmatic hernia probably existed in early times with other varieties of hernias it was never diagnosed in life and rarely noted at autopsy. Hippocrates wrote that large openings in the diaphragm never healed. One of the earliest cases was described in 1579 by Pare whose patient had had a penetrating wound in the chest and had apparently recovered from it when he developed obscure gastrointestinal symptoms and died. Autopsy showed that most of the colon had passed into the thorax through an opening the size of a finger.

Stehelinus in 1724 called attention to the absence of external signs and the difficulty of diagnosis in traumatic diaphragmatic hernia and he reviewed a number of cases that had been reported in the literature up to that time.

In 1761 Morgagni described diaphragmatic hernia in his treatise on pathologic anatomy. The first important study of it was made by Cooper in 1798 and his monograph on hernia contains the account of several cases. 2 of these were his own and the remaining number were reported by his friends. His excellent description of the anatomy and symptoms of this condition remains very valuable and his classification of the varieties of this form of hernia is used today.

There have been many cases of diaphragmatic hernia reported. In 1880 Lacher was able to collect 276 cases in the literature. Griffin in 1912 found 650 cases and Scudder in the same year found records of 53 patients who had been treated by operation.

Each succeeding year numerous papers were published on the subject. The condition is no longer considered a rare type of hernia and it seldom escapes the experienced roentgenologist. Statistics show that 1 to 4 per cent of individuals with upper abdominal or chest symptoms have some type of diaphragmatic hernia. Ivanissevich and Vaccarezza in 1932 published an outstanding monograph on the diagnosis and treatment of diaphragmatic hernia. Orr and Neff in 1936 reviewed the literature on diaphragmatic hernia in infants and children. Schiffbauer in 1939 published an excellent description of the thoracic operation. Harrington in 1939 reported 210 cases treated by operation. Hartzell in 1940 collected 68 cases in infants and children under ten years of age. Ladd and Gross in 1940 wrote at length on the treatment of infants and advocated operation within forty eight hours after birth. Wein

berg in 1941, presented a comprehensive review of the subject. Polley, in 1941, published an excellent review on diaphragmatic hernia and called attention to the coexistence of a diverticulum of the colon in 48.4 per cent of all cases. Wilkinson and Adams, in 1941, wrote on the operative treatment. Loeche, in 1942, found a hiatus hernia or dilated ampulla in 60.5 per cent of 38 cases examined. Opazo, in 1942, wrote at length on volvulus of the stomach in diaphragmatic hernia. Flores Williams, in 1942, discussed the diagnosis and treatment. Cossio and Fustinoni, in 1942, reported several diaphragmatic hernias that had been diagnosed as angina pectoris.

Ohler and Ritvo in 1943, reported that there were 128 cases of diaphragmatic hernia at the Boston City Hospital in less than four years. Turner, in 1943, was surprised to find that 673 papers were published between 1930 and 1939 on diaphragmatic hernia. Shofar, in 1945, discussed the medical treatment. Breca, in 1945, published a paper on the surgical treatment of strangulated diaphragmatic hernia. Sindels in 1945 wrote on diagnosis and the favorable results of medical measures in the treatment. Gariepy and Dempster, in 1945, reviewed the surgical treatment. Truesdale, in 1945, published an excellent paper on the technique of the thoracic operation. Lintz in 1946, emphasized the importance of the electrocardiogram as an aid in the diagnosis and distribution of accompanying cardiac symptoms. Dorsey, in 1946, discussed the surgical management of diaphragmatic hernia. Adams and Lee, in 1946, dealt with the diagnosis and treatment of diaphragmatic hernia. They prefer the transpleural operation for recurrent and traumatic hernia. Gilbert, Dey, and Rall, in 1946, studied the etiology of hiatus hernia and its treatment by a liberal ulcer medical regime, along with a reducing diet for those patients who were overweight. McNealy and McCallister in 1947, called attention to the advantages of a transabdominal repair with a subcostal incision.

### Diaphragmatic Hernia in Infants and Children

If the infant survives the first two days operative treatment should be undertaken. Ladd and Gross report a successful operation on an infant forty hours old and state that infants under forty eight hours old stand operation much better than those a week or two old. Within the first two days the intestine is collapsed and is much easier to replace in the abdominal cavity. This may prove impossible if operation is delayed until normal intestinal distention occurs. It is not advisable to give a barium meal to an infant or young child. Give plenty of fluids and a transfusion if necessary. Sometimes inhalation of 90 per cent oxygen is helpful. Before operation deflate the stomach with a tube and gastric suction and the colon by means of enemas.

Wilson and Trueman's little patient was successfully operated on at one month of age. Miller, Parmelee and Sanford reported two successful operations on infants under one year old.

### Frequency of Diaphragmatic Hernia

Diaphragmatic hernia is no longer considered a rare condition. Due to the perfected modern roentgen ray technique, small hiatus hernias are now detected

Approximately 1 to 4 per cent of patients who are subjected to upper gastrointestinal and chest roentgenograms are found to have diaphragmatic hernia, usually of the esophageal hiatus type. Harrington, in 210 cases of diaphragmatic hernia, summarized his findings as shown in the accompanying table.

DATA IN 210 CASES OF DIAPHRAGMATIC HERNIA IN WHICH OPERATION WAS PERFORMED

SITE OF OPENING	CASES	CAUSE	CONTENT OF HERNIA	CASES
Esophageal hiatus	153	Congenital (history of trauma, 12 cases)	Stomach (omentum)	144
			Stomach, omentum, and spleen	3
			Stomach and colon	6
(Short esophagus type)	11	Congenital	Stomach only	11
Hiatus pleuropertonealis	4	Congenital	Colon and small bowel	3
			Colon, small bowel, stomach, and spleen	1
Absence posterior fourth left diaphragm	4	Congenital	Stomach, colon, small bowel, and spleen	3
			Small bowel and colon	1
Foramen of Morgagni	2	Congenital	Colon and omentum	2
Left diaphragm	35	Trauma (indirect injury 25 cases direct injury, 6 cases)	Stomach only	5
			Stomach and colon	10
			Stomach, colon, and small bowel	5
			Stomach, colon, and spleen	2
			Stomach, colon, spleen and small bowel	0
			Stomach, colon, small bowel, and liver	2
			Stomach, colon, small bowel, spleen, and liver	2
Right diaphragm	1	Trauma (direct)	Stomach, colon, small bowel, liver (gall bladder), and head of pancreas	1
<b>TOTAL</b>	<b>210</b>			<b>210</b>

### Esophageal Hiatus Hernia

The most common type of hernia is that of partial or complete herniation of the stomach through the esophageal opening or hiatus. These are in turn usually grouped into three varieties as suggested by Akerlund: (1) congenital short esophagus with partial or complete thoracic stomach, (2) esophageal hiatus hernia with an esophagus of normal length which does not form any part of the hernia, (3) finally, an esophageal hiatus hernia with a shortened esophagus, the distal portion forming part of the hernial contents. While the symptoms are much the same for all three groups, the surgical treatment, as pointed out by Polley, presents more difficulties in the patient with a congenital short esophagus.

### Anatomy

Congenital diaphragmatic hernia differs in several respects from that in adults, and is best explained by a brief consideration of the embryologic development of the diaphragm.

**Development of the Diaphragm.**—The development of the diaphragm is customarily divided into two stages: the embryonic and the fetal. The pleural and peritoneal cavities are in direct communication with each other during the

embryonic period which terminates in the second month when the anterior and posterior portions unite in the median line. Should this union fail to take place a hernia without a serous sac will develop. It may be complete or incomplete and may be accompanied by other malformations.

The hernial opening in the embryonic type is usually on the left side and behind. This may be due to the fact that the right side of the diaphragm develops earlier than the left side and because the openings for the aorta and esophagus are a little to the left. Of 122 cases collected from the literature by Paillard the opening was on the left side in 94 and on the right side in 26. The foramen of Bochdalek is found between the two nonunited portions of the diaphragm, the septum transversum and the mass of the pillars and is usually crescentic in shape.

In the fetal type the hernial opening has no fixed location; the defect may be anywhere in the diaphragm. It is usually on one side; sometimes it is in front and rarely there may be more than one opening. The opening may be circular or oblong in shape if the hernia is due to deficient development. The orifice is covered by two layers, the peritoneum and the serous membrane of the pleura which form the hernial sac.

The early development of the liver prevents congenital hernia from appearing more frequently on the right side. In the case reported by Riggs the opening was between the right and the left lobes of the liver which were widely separated.

**Hernia Through the Normal Openings**—Congenital hernia may rarely occur through the normal openings of the diaphragm for the esophagus, aorta or vena cava of the three the hernia most often traverses the esophageal opening.

**Acquired Diaphragmatic Hernia**—Acquired diaphragmatic hernia may occur through the foramen of Bochdalek which is crescent shaped and is bounded in front by the converging fibers of the diaphragm, behind by the quadratus lumborum, at the inner side by fascia which is inserted into the transverse process of the second lumbar vertebra and at the outer side by fascia which is inserted into the twelfth rib. These hernias can also come through the parasternal orifice or foramen of Morgagni which is the interval between the adjoining ribs. This is a normal weak point in the diaphragm and is always very narrow except when the insertion into the seventh rib is deficient. These hernias may also break through a triangular opening which sometimes exists between the fibers arising from the internal and external arcuate ligaments. They also may enter the thorax through abnormal or buttonhole openings in the diaphragmatic muscle itself either near the center or at the edge (Fig. 177).

Traumatic hernias occur anywhere in the diaphragm and take the form of the instrument causing the wound as in cases in which hernia follows a bullet or a stab wound. If the cause is a crushing injury the hernia usually breaks through at one of the weak points.

**Course of the Hernia**—The hernia usually occurs through the lateral portion of the diaphragm and enters the thoracic cavity; sometimes it passes through the central tendon of the diaphragm and enters the pericardial cavity.



**Elevation of the Diaphragm**—Petit, in 1790, used the term *eventratio diaphragmatica* to describe a unilateral relaxation of the diaphragm, which is usually due to paralysis. Giffin in 1912 suggested that the term "elevation of the diaphragm" describes the condition more accurately. (Elevation of the diaphragm is not a hernia and the only reason it is considered here is because of its frequent confusion with hernia.)

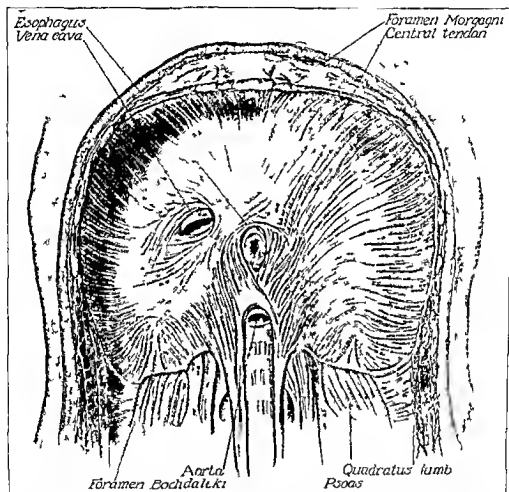


Fig. 177—The normal and acquired openings in the diaphragm. Congenital hernia rarely occurs through the normal openings in the diaphragm for the esophagus, aorta, or vena cava. Acquired diaphragmatic hernia may occur through the foramen of Bochdalek, the foramen of Morgagni, between the internal and the external arcuate ligaments, or through abnormal openings in the diaphragm itself.

**Frequency of the Varieties**—In 433 cases collected from the literature by Murray and Morgan, 232 were congenital, 181 acquired, and in the remaining number the variety was not stated.

Congenital diaphragmatic hernia is about eight times more frequent on the left side than on the right.

**Hernial Sac**—The hernial sac is composed of one or two layers of serous membrane. When there is one layer, it consists of the parietal membrane of

the pleura, which is very thin and may be adherent to other structures, when there are two layers, the sac is usually firm and well defined, and it is often impossible to separate the peritoneal and pleural layers, especially at the sides. Sometimes a thin layer of fat lies between the two membranes at the fundus of the sac.

In a majority of the cases the sac is absent. In 276 cases collected by Lacher, the sac was present in 28.

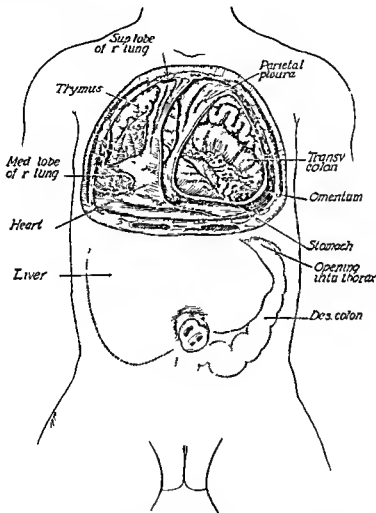


FIG 178.—True diaphragmatic hernia. This variety of hernia always has a sac and is usually congenital.

**True and False Hernias**—Some writers have classified diaphragmatic hernia according to the presence or absence of the sac, calling those with a sac "true" diaphragmatic hernia, and those without a sac "false" diaphragmatic hernia. Either of these varieties may be congenital or acquired, while the traumatic hernia is without a sac at all times (Figs 178 and 179).

**Contents of the Sac**—All the abdominal viscera have been found in the pleural cavity. In the order of frequency they are stomach, liver, intestine, colon, duodenum, pancreas, appendix and kidneys, several of these organs

may be found together. In the case observed by Vogel, omentum, stomach, transverse and descending colon, cecum, appendix, and small intestine were found. McDowell and Tondra found part of the liver, colon, and small intestine in the thorax.

**Stomach.**—The stomach may be wholly or partially within the hernia. A portion of the stomach wall may be caught in the hernial ring, a condition that Knaggs has compared to a Richter's hernia; a diverticulum of the stomach may be in the hernia or ulcers may form, even perforating in the herniated portion. Reischauer has reported a case of carcinoma of the stomach in a diaphragmatic hernia.

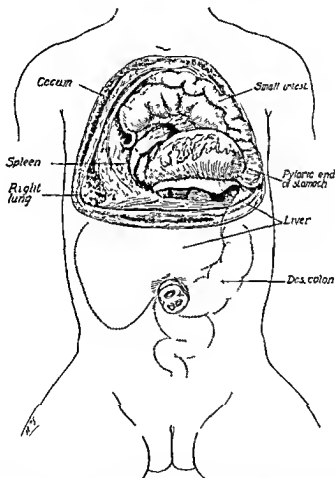


Fig. 179.—False diaphragmatic hernia. This variety of hernia has no sac, and may be either congenital or acquired. Traumatic hernia is of this type and consequently never has a sac.

**Large Intestine.**—The transverse colon is most often found in the hernia; the descending colon is next in frequency, and the ascending colon is most seldom present.

**Small Intestine.**—If the hernia is large, there may be several loops of the small intestine in it. In rare instances nearly all the small intestine is in the sac.

**Omentum**—Omentum may be found alone in the hernia, but it is more often associated with the stomach or the small or large intestine. It has a tendency to become adherent to the sac and the other contents, and may result in the hernia becoming irreducible or even strangulated.

**Liver**—The liver is rarely alone in the hernial mass, the whole of it or only one lobe may be present. If the diaphragmatic opening is very large, the liver may pass back and forth through the orifice with each respiration. When only one lobe is in the hernia, it is usually the right one.

**Spleen**—The spleen is seldom found alone in the hernia, usually being associated with the stomach.

**Kidney**—Diaphragmatic hernia of the kidney is very rare. Spencer saw a case, and Chambrelent and Princeps collected 4 cases from the literature. The left kidney is more often found in the hernia than the right one.

**Thoracic Organs**—The shape of the thoracic viscera is modified by the pressure of the hernia. In small and medium-sized hernias, the lungs are only slightly displaced and breathing is not greatly interfered with, in large ones, the pressure may be so great as to cause congestion and emphysema, and the heart may be displaced backward and upward with symptoms of pressure.

**Other Congenital Malformations**—Other congenital malformations are also associated with diaphragmatic hernia, such as harelip, cleft palate, absence of kidney, hydrocephalus, etc.

### Etiology

In the past there has been considerable controversy over the cause of diaphragmatic hernia. Cruveilhier divided these hernias into the congenital and the acquired varieties, and this classification was adopted by Laehr. I think they are more accurately described by the grouping originally proposed by Cooper, namely, congenital, acquired, and traumatic.

**1 Congenital Diaphragmatic Hernia**—The embryology of congenital diaphragmatic hernia has already been considered. Malformations may be present at birth, but the hernia may not be forced through the diaphragmatic opening until later in life, or it is possible for a small hernia to pass through a defect in the diaphragm and remain unnoticed, until a trauma causes it to increase in size. Truesdale states that the "thoracic stomach" is the result of embryologic failure of fusion and herniation through a congenital hiatus in the diaphragm. The short esophagus found in these patients is due to cessation of traction on the esophagus by the stomach, which is in the thorax.

To determine whether or not the hernia is of congenital origin, the site of the opening must be considered, the presence or absence of other malformations must be noted, and the formation of the sac studied, if there is one. (These points have been discussed at length under anatomy.) I believe that almost all hernias in adults that are customarily diagnosed as "congenital" are in reality traumatic.

**2 Acquired Diaphragmatic Hernia**—Acquired diaphragmatic hernia appears through one of the normal openings in the diaphragm, the esophageal, aortic, splanchnic or vena cava. It almost always occurs at the esophageal opening as this is the weakest point in the diaphragm (Fig 180). Protrusions through the aortic, splanchnic and vena cava openings are very rare. Platner reported a case through the aortic opening.

As in direct inguinal and acquired lumbar hernias, the acquired variety of diaphragmatic hernia follows indirect injury, strains such as lifting and coughing or a fall. Other factors that may favor it are obesity, emaciation, chronic bronchitis and laborious occupations.

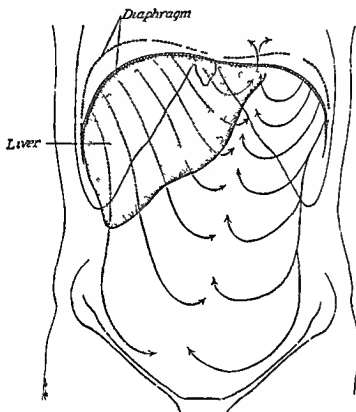


Fig. 180.—The effects of increased intraabdominal tension. When acquired diaphragmatic hernia follows a sudden increase in intraabdominal tension such as is caused by an indirect injury, strain or fall, it nearly always occurs at the esophageal opening, which is the weakest point in the diaphragm.

**3 Traumatic Diaphragmatic Hernia**—Traumatic diaphragmatic hernia usually occurs in adults and is most often found in men. It includes all hernias due to injury of the diaphragm. The injury may be direct, such as from a blow, a bullet or stab wound. It nearly always appears on the left side. Keene and Copleman reviewed the literature and found only 5 per cent of traumatic diaphragmatic hernia in the right hemidiaphragm. Blum and Ombredanne collected 9 cases following fracture of a rib. It may be indirect due to a crushing injury or any trauma that increases intraabdominal pressure sufficiently to rup-

ture the diaphragm. Weakening of the diaphragm due to disease, such as follows malignancy, empyema and subphrenic abscess, is a predisposing cause. (Fig. 181.)

Some writers believe that traumatic diaphragmatic hernia should be classified as an eventration, just as a protrusion of viscera through the abdominal wall is called a ventral eventration. I believe it is best to retain the term "traumatic diaphragmatic hernia" to designate those hernias due to injury, and use the word *eventration* only to describe elevation of the diaphragm, or the *eventratio diaphragmatica* of Petit and Thoma.

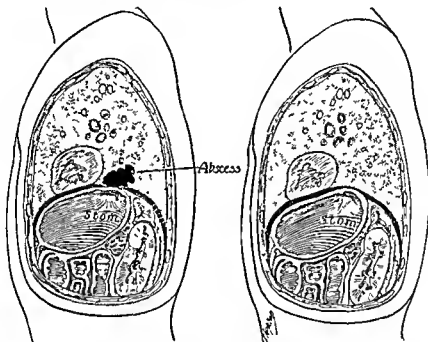


Fig 181—Subphrenic abscess This disease often weakens the diaphragm, thus favoring diaphragmatic hernia.

**Frequency of Hiatus Hernia**—Levy and Duggan, in 1941, found 26 cases of hiatus hernia in the course of 1,220 gastrointestinal examinations. Turner, in 1943, found 35 per cent of hiatus hernia in 1,500 upper gastrointestinal examinations. Saunders, in 1945, observed 28 cases of hiatus hernia and 3 of other types in the course of 2,100 upper gastrointestinal examinations. In 10 per cent of the patients with hernia there were no symptoms referable to the region of the diaphragm or esophagus.

**Age and Sex.**—Diaphragmatic hernia is most frequently found in patients of middle age, usually after fifty years of age. It is not common under thirty-five years, only 10 per cent developing before that age. Diaphragmatic hernia affects the sexes about equally, although it is somewhat more frequent in women.

### Symptoms and Diagnosis

The symptoms of diaphragmatic hernia are often indefinite, and it is only since the advent of the roentgen-ray examination that it has been possible to

diagnose the condition accurately during life. If the hernial opening is very large, both stomach and colon may be in the chest and as long as they can empty readily the condition may not be suspected. Meierdé saw a soldier who had had a congenital diaphragmatic hernia for twenty seven years without symptoms. A bullet penetrated the greater curvature of the stomach which was in the chest, and caused a fatal peritonitis.

It is most satisfactory to consider first the symptoms which may be either pulmonary or referred to the digestive tract and next the physical signs.

### Functional Symptoms —

*1 Pulmonary Symptoms*—The pulmonary symptoms are dyspnea which may be slight or so severe as to prevent the patient from lying down, pressure on the heart, which is manifested by syncope, irregularity and cyanosis, hic coughs which may be persistent.

In a number of cases found in the literature the pain has radiated to the shoulder and down the arm or along the upper border of the trapezius muscle as in the case observed by Carson and Huelsmann. The patient may complain of pain behind the sternum or at the sides of the thorax which is aggravated by pressure and by lying down. Epigastric pain is usually increased by pressure in Cranwell's patient it was increased by deep inspiration and coughing.

Relief is often experienced by change in position or by lying on the unaffected side. Symonds' patient suffered from a dull continuous pain which was aggravated by constipation and was partially relieved by assuming a crouching position. Vitrae's patient was relieved of pain by sitting down and flexing the body strongly forward.

*2 Digestive Symptoms*—Difficulty in swallowing is infrequent. Epigastric pain and digestive disturbances are often complained of. The pain may be severe and is sometimes described as burning or cutting in character, it may be colicky and if severe enough will cause nausea and vomiting. It usually comes on after meals and may be caused by small quantities of liquid food and is very severe following solid food. The patient may complain of food lodging in the chest where it causes a fixed pain. At other times a gurgling or rumbling sound may be heard in the chest.

Sometimes temporary relief follows the use of a strong cathartic. Occasionally hernias of a small portion of the stomach are relieved by eating, this is due to the drawing downward of the herniated portion of the stomach by the weight of food. If only omentum is in the hernia the symptoms are slight and indefinite consisting of indigestion and epigastric discomfort.

*3 Chronic Peptic Ulcer and Diaphragmatic Hernia*—The association of peptic ulcer and hernia is not uncommon. Diagnosis is often delayed because the ulcer symptoms overshadow those of the hernia. While the latter may improve the ulcer symptoms remain and as a result the hernia is overlooked or if it has been recognized its treatment is neglected. Dick and Hurst believe the condition is much more frequent than is generally supposed. The short esophagus along with a diaphragmatic hernia allows the acid contents of the stomach to regurgitate into the esophagus and produce an ulcer.

In the group of diaphragmatic hernia studied by Polley, the frequency of the symptoms were as follows: epigastric pain or distress after eating, 83 per cent, associated with bloating and belching, 44.7 per cent, with heartburn, 31.9 per cent, nausea and vomiting, 47 per cent, regurgitation, 30 per cent, night pain, 23.4 per cent, dysphagia, 17 per cent, dyspnea, 12.7 per cent, chest pain, 14.9 per cent, gastric hemorrhage, 8.5 per cent, and angina and cough less frequently.

**Hemorrhage in Hiatus Hernia**—Hemorrhage is commonly due to bleeding from ulceration of the esophagus or gastric mucosa. When the stomach is in the hernia and is irreducible or reduces only with difficulty, the hemorrhage may be severe. Murphy and Hay consider anemia second only to pain in the diagnosis of hiatus hernia.

**Physical Signs**—The physical signs are often as vague as the subjective symptoms. Litten's sign, which is a movable horizontal depression on the lower part of the side of the thorax seen during respiration, is usually absent on the affected side. A depression may rarely be seen in the epigastric and left hypochondriac regions with a corresponding fullness over the lower part of the thorax. Auscultation over the lung on the affected side may elicit a feeble vesicular murmur—sometimes even this will be absent. The respiratory sounds may not be audible at the base of the lung, but will be normal at the apex, and are usually lessened with the patient in the knee chest position. Percussion will reveal a displacement of cardiac dullness, usually to the right, and the lower part of the thorax will give a resonant sound if the hernia contains empty stomach and intestine, a dull sound will be obtained if solid viscera are in the hernia, or if the herniated stomach and intestine contain fluid. If the hernia contains hollow viscera, abnormal sounds, such as gurgling, splashing, metallic tinklings and borborygmus may be heard. The efforts of the older surgeons to diagnose the condition were interesting and ingenious, and although dangerous, are worth remembering when diagnosis has to be made without the aid of the roentgen ray, which is our most reliable means at the present time. Some recommended auscultation after the patient has taken food or had drunk an abundance of water. Leichtenstern inflated the stomach through an esophageal tube, and by auscultation he could hear a whistling sound in the thorax and the patient's breathing became embarrassed. Other surgeons inflated the stomach with an effervescent powder before examining the hernia, and if hernia of the transverse colon was suspected, they inflated the tumor by injecting air through the rectum.

**Diaphragmatic Hernia in the Newly Born**—Congenital diaphragmatic hernia in infants presents no characteristic symptoms. There is usually a marked cyanosis and great difficulty in breathing, and, as a rule, death occurs in a few hours. In 57 cases collected from the literature by Funck Brentano, 51 patients died within the first twenty-four hours.

**Roentgen Ray Diagnosis**—The roentgen ray represents the most important means of diagnosis in nonstrangulated diaphragmatic hernia. The routine use of this method in gastrointestinal examination has resulted in the discovery of many unsuspected or symptomless hernias of the diaphragm. Pérez Fontana



has successfully diagnosed hernia in infants and children by roentgen ray examination

**Position for Roentgen Ray Examination**—The recommended roentgenologic technique for suspected diaphragmatic hernia is a fluoroscopy with the patient in the horizontal or Trendelenburg position, with ingestion of the barium meal while in one or both of these positions during the examination. When no adhesions are present, the diagnosis of hernia may be possible only as part of the stomach passes through the esophageal hiatus during a deep inspiration or while the opaque meal is being swallowed.

Often the hernia cannot be seen if the examination is made only with the patient in the upright position, and most of the small hernias will be missed. Therefore, it is necessary always to examine the patient in the prone position with increased intraabdominal pressure. An inflated rubber pad or balloon will exert the required pressure, or it is secured by asking the patient to take a deep breath while his shoulders are raised and his thighs sharply flexed on the abdomen.

Sahler and Hampton emphasize that the diagnosis of hiatus hernia depends upon (1) an asymmetrical relationship between the lower end of the esophagus and the herniated fundus of the stomach, and (2) a narrowing of the fundus where it passes through the diaphragm.

**1 Examination Without Opaque Meal**—Fluoroscopic examination will show loss of the normal bowline of the diaphragm on the side of the hernia, which is usually on the left involving the stomach. The air bubble of the stomach is absent, and a part of the stomach or all of it may be visible above the diaphragm. When several viscera are in the hernia, there may be a number of rainbow like lines cast by the rounding tops of the air bubbles in the different organs. The curving in of the sides of the stomach, due to the constriction of the hernial ring, is a valuable sign, and is best seen with the patient in the standing position. There is retraction and elevation of the lung on the affected side and lung tissue can be seen through the gas bubble. The heart may be displaced to one side or its position may be influenced by the fullness of the stomach or colon in the hernia.

**2 Examination With Opaque Meal**—On account of the toxic symptoms that sometimes follow the use of bismuth, it has been generally replaced by barium for gastroenterologic roentgen ray examinations. The preliminary opaque meal consists of barium sulphate emulsified in buttermilk or other suitable liquid, 12 to 16 ounces (350 to 500 cc) usually being sufficient. This may have to be drunk very slowly on account of the pain and pressure symptoms. If the solution is cold, there is less tendency to nausea and vomiting.

The examination should always be made by the fluoroscope as by this means it is possible to recognize small hernias that are liable to escape detection by the plate method (unless a series of plates are made with the patient lying down, and the pelvis raised), the barium will be seen to enter the portion of the stomach above the diaphragm, and a little later it will reach the duodenum. If the presence of colon in the hernia is suspected, the opaque meal must be watched at intervals until it passes the splenic flexure, or the

barium can be given by enema, at a second examination (Figs 182, 183, and 184) The viscera in the hernia are most apparent with the patient in the reclining position. The constriction of the stomach by the hernial ring should not be mistaken for an hour glass contraction of the stomach. It is also well to examine the patient as he lies on his side, so that the barium line will be at a right angle to the bow line of the diaphragm. A good idea of the reducibility of the hernia and the extent of pleural or pericardial adhesions can be obtained by examining the patient in different positions. Marks stated that the different types of diaphragmatic hernias can be diagnosed by x ray examination.

**Esophagoscopy**—When the roentgenologic examination fails to show a hiatus hernia, though the symptoms are suggestive of it, an esophagoscopy should be done. This will determine whether the esophagus is of normal length or congenitally short and whether or not a hernia is present, also, if ulceration or a new growth is present. In the latter case a specimen can be secured for biopsy to determine whether an operation should be undertaken or deferred.



Fig 182

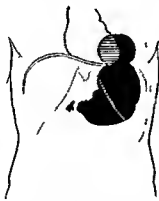


Fig 183

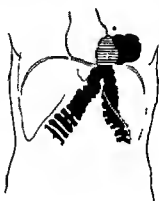


Fig 184

Roentgen ray examination.

Fig 182.—Hour glass appearance of the stomach and air bell in thorax with patient in standing position

Fig 183.—Disappearance of air bell with patient in prone position

Fig 184.—Splenic flexure in thorax

**Complications**—1 *Strangulated Diaphragmatic Hernia*—The transverse colon is most often strangulated, the stomach is next in frequency, and rarely the small intestine is strangulated. The condition usually follows a sudden strain, or trauma which forces a considerable quantity of viscera through the opening into the thorax. The general symptoms of strangulation in diaphragmatic hernia are similar to those in other varieties of hernia. The pain is sudden, severe, and localized in the epigastric region. There is profound shock, dyspnea is very marked, the diaphragm is immobilized, and respiration is of the superior costal type. The signs of obstruction depend on the viscus that is strangulated. Tuley has reported a case in which the stomach and the colon were strangulated. Foster saw a case in which the stomach and most of the small intestine were in the hernia, and a torsion of the mass had caused a volvulus in the midportion of the ileum that resulted in secondary gangrene of 24 inches (60 cm) of the small intestine.

2 *Rupture of Viscera in the Hernia*—Rupture of the abdominal viscera contained in the hernia is an unusual complication. The stomach is ruptured most often, the liver and spleen less frequently, and the intestine and colon very rarely.

3 *Other Complications*—Wounds of the thorax and abdomen may complicate diaphragmatic hernia. In the case reported by Prat, omentum protruded through a left lumbothoracic wound. The omentum was resected and the wound dressed. (There were no symptoms of diaphragmatic hernia.) Peritonitis developed, the patient died, and at autopsy the stomach was found in the thorax.

There are a number of cases recorded in the literature in which the patient has been operated on for stomach trouble, gallstones or appendicitis, and the diaphragmatic hernia was left undiscovered until a subsequent operation for unrelieved symptoms or at autopsy. Routine examination of the diaphragm, as well as other hernial openings, should be the rule in every laparotomy with obscure symptoms of intestinal obstruction. In traumatic diaphragmatic hernia, rupture of intraabdominal viscera may also occur.

### Differential Diagnosis

Diaphragmatic hernia may occur with hernia in other regions and it must not be mistaken for the following conditions:

1 *Pneumothorax*—In pneumothorax there are no subjective symptoms of hernia, and no intestinal or stomach sounds can be heard in the thorax. Roentgen ray examination shows an abnormal clearness corresponding to the air in the pleural cavity, and the stomach and intestines are seen below the diaphragm. If a hernia is mistaken for a pneumothorax, and aspirated, the result may be fatal.

2 *Fluid in the Thoracic Cavity*—The thoracic cavity may contain a colorless fluid, blood or pus. The symptoms are similar to those of pneumothorax, except when there is empyema, there will be chills, fever and other symptoms of sepsis. Roentgen ray examination easily excludes hernia. In Mercade's patient, who had a bullet wound through the stomach in the chest, the symptoms of perforation were treated for a hemothorax.

3 *Injury of Other Viscera*—In traumatic hernia the heart, lungs, pleura and the nonherniated abdominal viscera may be injured; there may be hemorrhage from severed blood vessels, and also peritonitis if the stomach or intestines have been ruptured. These complications may make diagnosis impossible before operation.

4 *Elevation of the Diaphragm*—Elevation of the diaphragm is difficult to differentiate from diaphragmatic hernia. According to Giffin, the three most important signs of diaphragmatic hernia are a destruction of the definite dome shape of the normal diaphragm line, the appearance of lung tissue through the gas bubble in the chest, and the demonstration of the colon above the bow line of the diaphragm. These symptoms are lacking in elevation of the diaphragm.

Keith (D Y) gives the following roentgen ray table for differential diagnosis

EVENTRATION	HERNIA
High dome of the diaphragm with no loss of contour No gas shadows above liver shadow More likely to be congenital Paradoxical movement of the diaphragm	High diaphragm with loss of contour, a portion being regular, and a portion blurred Gas or barium shadow seen above liver shadow Gastric deformity Obstruction Presence of gas or fluid, or both, in the hernial sac

**5 Diverticulum of Esophagus**—Small diverticula of the lower end of the esophagus may be mistaken for diaphragmatic hernia of the stomach at roentgenologic examination this mistake has been made by experienced radiologists

**6 Angina Pectoris and Hernia**—Diaphragmatic hernia is sometimes mistaken for angina pectoris. The history of the attacks in relation to food intake along with the age of the patient are helpful in making a diagnosis. While both conditions may exist in the same patient, the hernia pain usually radiates to the back and is not related to effort as in the case of angina pectoris. In the latter disease the pain radiates to the substernum, left shoulder and arm, and sometimes to the neck and jaws. Abowitz advises that patients with a typical angina and pain which is aggravated by eating should be examined for hiatus or diaphragmatic hernia. Lintz stresses the value of the electrocardiogram as an aid in the diagnosis of diaphragmatic hernia and the distribution of cardiac symptoms. Jones and Chapman noted that during distention the esophageal pain was often referred to the substernal area, the shoulder, and along the ulnar nerve distribution of the left arm, thus simulating the pain of angina pectoris. Cossio and Fustinoni reported five cases of diaphragmatic hernia that were mistakenly diagnosed as angina pectoris.

**7 Other Diseases**—Hiatus hernia, a dilated esophageal ampulla, and a true diaphragmatic hernia must be differentiated from the following: cardiac spasm and angina pectoris, tumors of the esophagus or nearby structures that produce pressure, cancer of cardiac portion of stomach or esophagus, gastric and duodenal ulcer, stricture or obstruction of the esophagus, tumor of the lung, cholecystitis, and appendicitis. Blades and Berger in 1946, reported a case of diaphragmatic hernia that was treated for cholecystitis.

### Prognosis

The prognosis for small hiatus and true diaphragmatic hernia is favorable. The symptoms, which are often vague and indefinite and are referred to the gastrointestinal tract, are amenable to medical treatment and diet. Saunders concludes that 80 per cent of small hiatus hernia will respond to medical management and do not need surgery.

For large diaphragmatic hernia that are accompanied by severe symptoms and disability, the outlook is not so favorable. The course of the disease, if progressive, may terminate in strangulation of abdominal viscera in the thorax. Palliative treatment has little effect on these large hernias. All the patient can

do is to follow a restricted diet and avoid all forms of physical exertion, to lessen the danger of strangulation. When there are nausea and vomiting, cold food is tolerated best. Liquids and soft foods cause less pain than solid or coarse foods. Mathews and Imboden's patient with hernia of the stomach experienced



Fig. 183.—The abdominal incisions for diaphragmatic hernia. The abdomen is opened by an incision above the umbilicus in the midline or by a lateral rectus incision or by one of the gallbladder incisions. The Eber's S incision is one of the best.

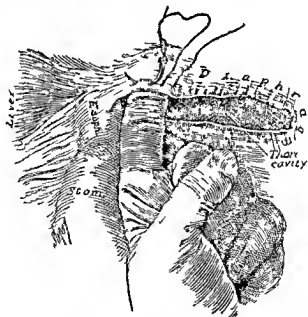
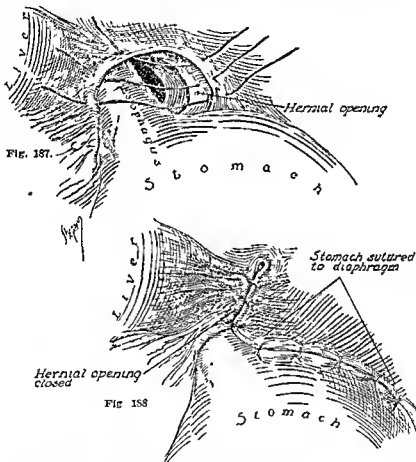


Fig. 184.—Closing the opening in the diaphragm. It is important that each stitch takes a deep bite into the muscle which is pulled down by the forefinger.

the least discomfort with a diet of a small quantity of meat, potatoes and eggs, the symptoms were aggravated by soups, desserts and green vegetables.

Because of the obscure symptoms this disease is often not suspected, consequently operation is not undertaken at the most favorable time. The outlook

is always grave; however roentgen-ray examination makes an early diagnosis possible, and prompt operation has reduced the mortality of strangulated and traumatic hernia 50 per cent. Harrington advises phrenicotomy when the patient's condition will not permit an operation. Phrenicotomy will prevent spasm of the diaphragm which causes the severe attacks of pain associated with incarceration of the stomach. Truesdale urges early operation for infants and young children and believes it is safe if the surgeon is careful to avoid the dangers of unilateral thoracic pressure during operation.



Closing the opening in the diaphragm.

Fig. 187.—When the esophageal opening is small, the edges of the diaphragm can be readily brought together and stitched with interrupted or mattress sutures.

Fig. 188.—The sutures in the diaphragm have been tied. To lessen the danger of recurrence, the wall of the stomach is anchored to the diaphragm.

Mortality in the newly born is very high; there is usually no treatment for them, and 90 per cent die within the first twenty-four hours. Their only chance for survival lies in operation immediately after birth.

### Treatment

Formerly it was believed that all hiatus and true diaphragmatic hernias required operation. Now we know that most of the small hernias are amenable to medical management. On the other hand, a large hernia, with a portion of the abdominal viscera in the thorax, should be treated by operation.

**Medical Treatment**—The majority of small hiatus hernias have few or no symptoms and respond well to medical measures. The patient who follows instructions is usually comfortable and can continue with his regular occupation.

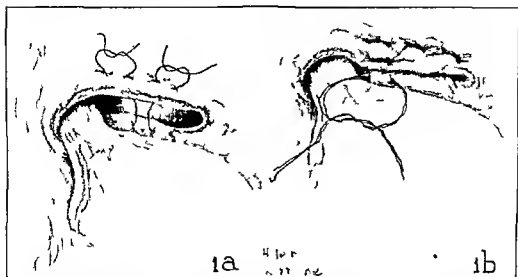


Fig 180—Method of closing small hiatus hernia with mattress sutures. A large stomach tube is in the esophagus.

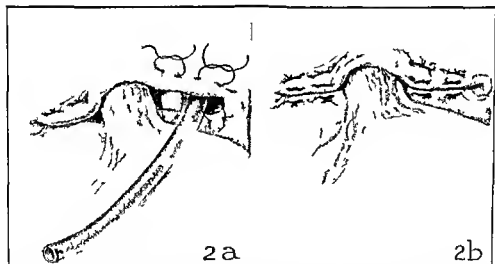


Fig 190—Closure of large hernia of the diaphragm. The air is aspirated from the pleural cavity through the catheter as the last suture is tied.

**1 Diet**—A bland diet with a high vitamin content is the best. There should be five or six feedings daily with no food or fluids after 4:00 P.M. All fluids should be taken between meals. The patient is most comfortable if he sits upright while eating and for a short while afterward. Alkalis such as aluminum

hydroxide, and antispasmodics are best taken between meals. Some form of iron should be given if the patient is anemic. The diet should be of small bulk, and foods that lead to gas formation should be avoided, such as hot soups, peas, beans, onions, cabbage, cauliflower, etc.

2. *Rest.*—The patient should rest in a sitting rather than in a prone position. Sleeping at an angle of 45 degrees is helpful. Rest one-half hour before eating. Patients should do no heavy work and avoid straining and lifting from a stooping position. The obese patient will be more comfortable if he loses weight.

3. *Peptic Ulcer and Hiatus Hernia.*—A strict ulcer diet with medical therapy should be observed. The use of antispasmodics and alkalis should be undertaken, especially aluminum hydrate or hydroxide, which has a prolonged action and does not cause gas formation as in the case of preparations that contain sodium bicarbonate.

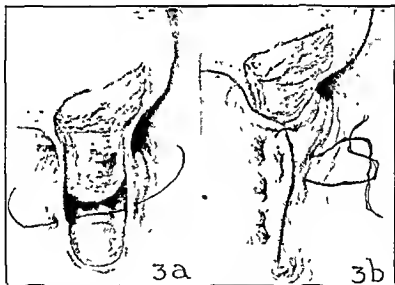


Fig 191—Cutting the stomach free from its attachment to the hernial sac. The margins of the hiatus are overlapped with heavy mattress sutures of silk or fascia.

### Operation for Diaphragmatic Hernia

It is only in recent years, with the improved methods of diagnosis, that nonstrangulated diaphragmatic hernia has been recognized early and treated by operation, resulting in the development of a successful surgical technique.

On account of the severity of the symptoms and the dangers of strangulation, the radical operation by the abdominal route is the treatment of choice. (Fig 185.) The thoracic route is preferred by Maier for hiatus hernia and traumatic diaphragmatic hernia in adults.

1. *The Abdominal Route.*—The abdominal operation is used by most surgeons because it is followed by less shock and fewer complications than the



**Medical Treatment**—The majority of small hiatus hernias have few or no symptoms and respond well to medical measures. The patient who follows instructions is usually comfortable and can continue with his regular occupation.

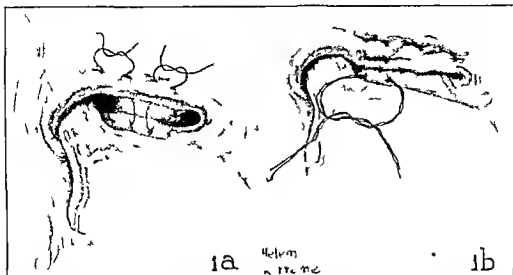


Fig 189—Method of closing small hiatus hernia with mattress sutures. A large stomach tube is in the esophagus.

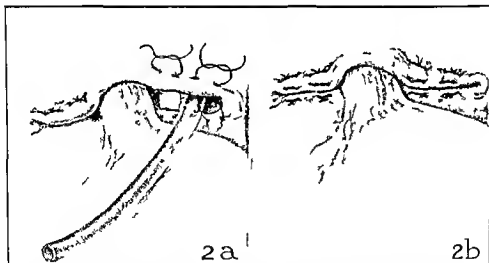


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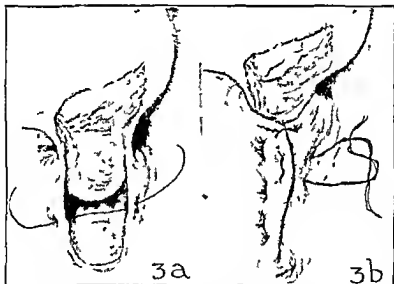


Fig. 191.—Culling the stomach free from its attachment to the hernial sac. The margins of the hiatus are overlapped with heavy mattress sutures of silk or fascia.

### Operation for Diaphragmatic Hernia

It is only in recent years, with the improved methods of diagnosis, that nonstrangulated diaphragmatic hernia has been recognized early and treated by operation, resulting in the development of a successful surgical technique.

On account of the severity of the symptoms and the dangers of strangulation, the radical operation by the abdominal route is the treatment of choice (Fig. 185). The thoracic route is preferred by Maier for hiatus hernia and traumatic diaphragmatic hernia in adults.

1 *The Abdominal Route*—The abdominal operation is used by most surgeons because it is followed by less shock and fewer complications than the

thoracic operation. The abdominal route is indicated when there has been injury to abdominal viscera and when there are symptoms of intestinal obstruction. It enables the operator to confirm the diagnosis promptly, and in case intestinal resection is necessary it affords better exposure and permits a quicker repair. The patient suffers less from shock following laparotomy than after thoracotomy.

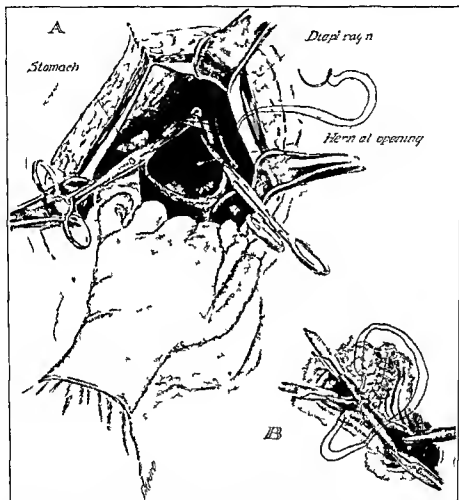


Fig. 19.—Closing the opening in the diaphragm.

*A* In closing a large opening the edges of the anterior part which are most accessible are approximated with the aid of traction forceps and the anterior two-thirds of the defect closed with a long continuous suture.

*B* The posterior one third is then easily closed by picking up the most distant edge of the remaining opening and suturing on a line at a right angle to the first suture line.

**Anesthesia**—While any inhalation anesthesia can be used cyclopropane is the best and is preferably given with an intratracheal tube. If a hernial sac is present it can be administered by the closed mask method. The anesthesiologist should be prepared to give pressure anesthesia should it become necessary.

**Operation.**—Preliminary interruption of the phrenic nerve is advisable to make the operation easier. It causes relaxation of the diaphragm, facilitates reduction of the hernia, and narrows the hernial opening, thus aiding in the closure of the wound. This can be accomplished by a nerve block, but it is more satisfactory to crush the nerve in the cervical region or along its course in the mediastinum during the operation, as advised by Harrington. The paralysis is only temporary and clears up in a few months.

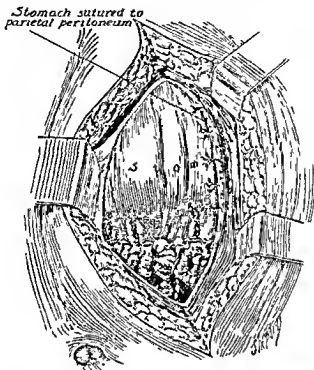


Fig. 183.—Closing the opening in the diaphragm. When the esophageal opening in the diaphragm cannot be completely closed, recurrence may be prevented by suturing the stomach to the peritoneum of the abdominal incision.

The patient is placed in the Trendelenburg position and the abdomen is opened by an oblique rectus incision, starting near the ensiform cartilage and extending to the outer border of the rectus muscle. Next, the suspensory ligament of the left lobe of the liver is divided so that it can be retracted back out of the way by broad spoon retractors. The method of closure of the diaphragmatic opening depends on its size and location. If the defect is small and can be brought together easily, all that is necessary is to close the diaphragm with heavy silk or cotton interrupted sutures. Before the opening is finally closed, Harrington introduces a catheter attached to a suction pump and all the air is aspirated from the pleural cavity; as the last stitch is tied the catheter is withdrawn. While suturing, a large caliber stomach tube is passed through the esophagus into the stomach. This facilitates the closure and at the same time obviates the danger of constriction of the esophagus by a tight closure of the wound. In large hernias, Harrington reinforces the usual stitches with fascia lata sutures. When it is impossible to close the opening in the diaphragm on

account of the patient's critical condition the stomach can be tacked to the peritoneum of the abdominal incision. The abdominal wound is closed in layers with interrupted sutures of silk or cotton. Harrington advises the maintenance of respiratory function with positive pressure anesthesia during operation and always establishes a negative pressure in the thorax at the end of the operation. To be sure of the latter a roentgenogram is made of the patient's thorax before leaving the operating table (Figs 186 to 193).

Frick points out that when there is difficulty in reducing the hernia a catheter introduced into the pleural cavity will let in air and aid reduction. If the hernia cannot be reduced and the patient's condition does not permit opening the thorax a gastrojejunostomy can be done if the transverse colon is in the hernia the ascending and the descending colon can be anastomosed.

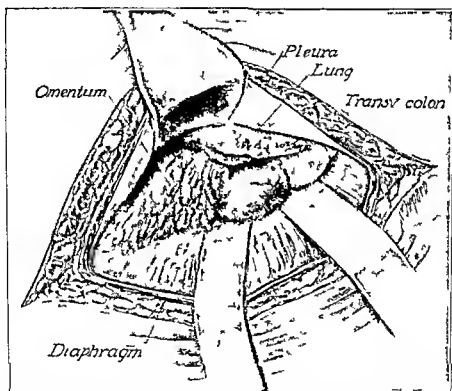


Fig. 194.—The thoracic operation. It is easier to deal with the hernia through a thoracic incision than through an abdominal incision because the hernia is more accessible through the thorax. The thoracic approach is indicated when there is traumatic injury of the pleura, lungs, heart or blood vessels accompanied by hemorrhage.

**2 Thoracic Route**—The thoracic operation should be used when there is traumatic injury of the pleura, lungs, heart or blood vessels accompanied by hemorrhage. The wound in the chest acts as a guide down to the hernia which can be freely exposed simply by enlarging the wound (Figs 194 and 195).

The thoracic route should be reserved for those rare cases of hernia through the right hemidiaphragm because the large right lobe of the liver makes it

difficult to reach the abnormal opening in the diaphragm. The thoracic operation or the combined operation should be employed for the infrequent case of diaphragmatic hernia that cannot be reduced from below the diaphragm. Truesdale believed there is less danger of injuring the esophagus by the thoracic route and stated that this accident carries a high mortality rate. The advantages of the thoracic route are: it is easier to deal with the hernia because it is nearer the surface than when approached from the abdomen, the hernia can be more readily reduced, and the adhesions to the pleura and pericardium can be freed, and it is less difficult to close the opening. However, these apparent advantages are not sufficient to offset the serious disadvantages of increased shock and serious complications that follow the thoracic operation.

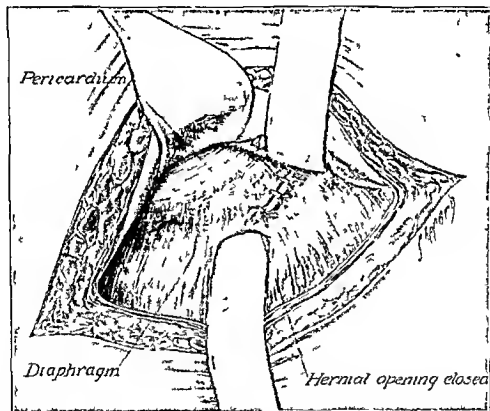


Fig. 195.—The thoracic operation. The opening in the diaphragm is easily closed by interrupted sutures.

**Operation**—The patient is usually placed on the table in a lateral position. The intercostal space is widened by means of a pillow or sand bag under the chest. The incision is made in the eighth or ninth intercostal space and is 4 to 5 inches (10 to 12.5 cm) in length. Strong retraction is made and the ribs are widely separated, it is usually possible by this means to avoid the resection of one or more ribs. If the exposure is insufficient, it is necessary to resect the costal arch. Time is often saved by immediately resecting a long piece of the eighth rib.

I believe that the best exposure is obtained by an incision which begins at the lower edge of the rib at the end of the xiphoid cartilage, divides the rectus muscle, and enters the intercostal space between the ninth and tenth ribs without opening the pleura (Figs 196 and 197)

The hernia is reduced, the excess of sac is folded upon itself and used as a pad to close the opening, or the sac can be resected and the edges overlapped and sutured. The edges of the hernial opening are brought together by interrupted sutures of heavy silk or linen, or one of the methods of closure described under the abdominal operation can be used here.

To quiet the diaphragm while suturing the hernia opening, Halsted advises blocking the phrenic nerve on the side of the hernia. This procedure will keep the diaphragm quiet for several hours.

When the opening in the diaphragm cannot be closed by ordinary means it can be accomplished sometimes by resecting the ribs in front of the hernia. The danger of pneumothorax is generally overestimated, if the chest is opened gradually, the symptoms are slight. A differential pressure cabinet is unnecessary. If dyspnea appears during operation, the lung should be drawn down to the wound and steadied with soft rubber-covered forceps. Before completing the operation, a small blunt trocar attached to a syphon bottle should be inserted into the pleura. At the completion of the suture all the air in the chest can be readily aspirated, and the lung reexpanded.

If the chest has been opened under local anesthesia, the patient can be allowed to come out of the general anesthetic as soon as the diaphragm is closed, with assistance, he can close his mouth, hold his nose, and by blowing, expand the lung as the final suture is tied. If there is danger of infection, or if there has been an extensive separation of adhesions, a drain can be left in the pleura, however, when possible, the wound should be closed without drainage.

**3 The Combined Operation**—The combined operation is the treatment of choice in a great many cases and it is being used with increasing frequency. Often it is necessary to open both the thorax and the abdomen, to reduce the hernia and to deal with complications. Some operators prefer to open the thorax and then the abdomen by separate incisions. Others use the single incision which exposes both cavities simultaneously.

Schwartz and Quénu recommend the combined thoracoabdominal route in all cases. The incision begins in the axillary line and extends forward in the seventh intercostal space. The pleural cavity is opened, care being taken to avoid a too sudden pneumothorax or injury to herniated viscera that may be adherent to the chest wall. The incision curves downward over the rectus muscle to the midline, and then down to the umbilicus. The peritoneal cavity is opened, the cartilaginous portion of the ribs at the site of incision, is cut with scissors, and the incision continued in a straight line through the diaphragm to the hernial opening. The adhesions are separated, the viscera reduced, the margins of the opening freshened and sutured, the cartilaginous edges brought together, and the wound is closed. If necessary, a drain can be left in the lower part of the pleural cavity for two or three days (Fig 198). Auvray resected the ninth rib and continued the incision down to the umbilicus. He cut through

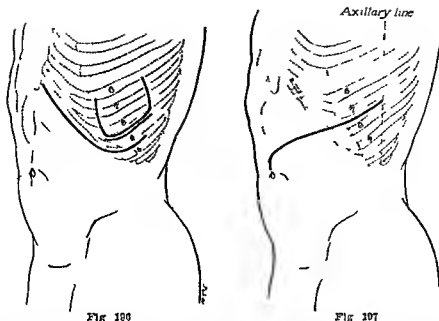


Fig 196

Fig 197

Fig 196—The thoracic operation. The principal incisions are illustrated (For description see the text)

Fig 197—The combined thoraco abdominal operation. The incision begins in the axillary line and extends forward in the seventh intercostal space. The pleura is opened. The incision curves downward over the rectus muscle to the midline and then down to the umbilicus. The peritoneal cavity is opened and the cartilaginous portions of the ribs are cut with scissors. The diaphragm is cut through to the hernial opening.

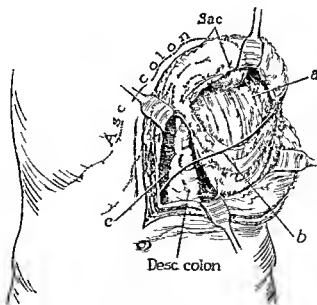


Fig 198.—The combined thoraco abdominal operation. *a* The thoracic cavity. *b* loop of strangulated colon. *c* the abdominal cavity.



the ninth costal cartilage and incised the diaphragm up to the hernial opening. The hernia was reduced, the opening sutured, and the wound closed.

**Strangulated Diaphragmatic Hernia**—Strangulated diaphragmatic hernia is not common because small intestine is seldom part of the hernial mass. When it does occur, the treatment is the same as that for strangulation elsewhere.

**Postoperative Treatment**—The patient should be kept warm and given intravenous solutions of glucose and normal salt. If in shock or if the systolic blood pressure falls below 90 mm, a blood transfusion or blood plasma is indicated. Other measures are helpful: an oxygen tent, 60 per cent oxygen, immediately after operation for a few hours, gastric suction tube and a low rectal tube or catheter for the first week.

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## CHAPTER XXV

### INTERNAL HERNIA

**Synonyms**—Retroperitoneal hernia, Cooper's hernia, antepitoneal hernia, hernia of Treitz, intraperitoneal hernia

**Definition**—An internal hernia is a protrusion of abdominal viscera into one of the internal abdominal fossae

#### Historical

The duodenal fossa was first described by Hensing, in 1742. Haller, in 1754, spoke of it, Bordenave, in 1779, briefly described a case of duodenal hernia, Sandifort, in 1777, noted the opening, Neubauer, in 1786, observed a left duodenal hernia in which all of the small intestine was in the hernia sac, Monro, in 1803, called the opening the duodenal *ring*, Cooper observed a hernia in this fossa, and Husehke, in 1844, described the fossa as triangular in shape. It remained for Treitz's classical description of the anatomy of this hernia, which appeared in 1857, to establish the importance of internal hernia into the peritoneal fossae.

Husehke and Treitz described a single duodenal fossa, a different one was described by Eppinger in 1870, Gruber, in 1896, and Landzert, in 1871, noted two duodenal fossae, Jonnesco described an additional one in 1890, and two more a little later, Broesike, in 1891, published an important summary of the literature up to that time, and Moynihan in 1906, described 9 duodenal fossae.

Hertzler, in 1919, published his monograph on the peritoneum and the peritoneal fossae, Steiner, in 1932 reviewed the literature and proposed a simple classification of internal hernia, Longiere, in 1934, collected 140 cases in the literature and discussed the cause of these hernia, de Oliveira in 1935, published a comprehensive review of transmesocolic hernia with a case. In 1936, Cullen wrote on mesenteric hernia of the colon with strangulation, and Winterfeld reported a case of incarceration of the small intestine in the fossa of Treitz which caused necrosis of the pancreas.

In 1937, Silvestrini discussed the pathology of hernia into the fossa of Treitz, while Watson (J. R.), wrote on obstruction due to mesenteric defects, Bona, in 1938, commented on mesenteric holes as a cause of intestinal obstruction, Hausmann and Morton, in 1939 wrote on intraabdominal hernia, Bird, in 1940, published an excellent monograph on internal hernia and a new classification of these hernia, Kaiser, in 1940, recorded a case of presternal hernia of the liver, Baistrocchi, in 1941, reported an unusual case of strangulation of an internal hernia caused by an attack of acute appendicitis, McCarty and Present, in 1944, emphasized the importance of roentgen ray studies in making a preoperative diagnosis of hernia, Cntler and Scott, in 1944, reviewed 50 cases of transmesenteric hernia including 4 of their own. Lahey and Trevor, in 1945, conclude that roentgen ray preoperative diagnosis is usually possible, and outline

the operative treatment Biemann in 1946 reviewed the literature and discussed the etiology of hernia into the duodenojejunal fossa Gariepy and Capano in 1947, reported a rare transmesenteric hernia in an infant six months old

### Varieties of Internal Hernia

A simple classification of internal hernia is the one proposed by Steinke

#### Retroperitoneal —

- 1 *Paraduodenal*  $\begin{cases} \text{right} \\ \text{left} \\ \text{duodenojejunal} \end{cases}$
- 2 *Paracecal*  $\begin{cases} \text{ileocecal} \\ \text{retrocecal} \\ \text{ileocolic} \end{cases} \begin{cases} \text{superior} \\ \text{inferior} \end{cases}$
- 3 *Intersigmoid*
- 4 *Foramen of Winslow*

#### Anomalous Openings (Anteperitoneal) —

- 1 *Through the mesentery*
- 2 *Through the omentum*
- 3 *Through or into the broad ligament*

Bud has suggested another grouping of internal hernia that is very practical Prevesical hernia and hernia into the broad ligament are dealt with in their respective chapters

**Frequency of Intraabdominal Hernia.**—Paraduodenal is the most common type of internal hernia and it occurs on the left side three or four times as frequently as on the right After paraduodenal hernia the order of greatest frequency is as follows transverse mesocolon mesenteric foramen of Winslow pericecal intersigmoid ileoappendicular ileocolic ascending mesocolon and great omentum

Hansmann and Morton collected from the literature 467 cases as shown in the accompanying tables The sex was given in 454 patients (Fig 199)

SITE	CASES	MALES	FEMALES	SEX NOT DETERMINED
Left paraduodenal	139	41	18	71
Transverse mesocolon	60	15	31	11
Right paraduodenal	47	8	6	13
Mesenteric	38	21	9	8
Foramen of Winslow	3	19	6	19
Paracecal (pericecal)	31	19	4	8
Intersigmoid	29	20	7	1
Broad ligament	18		19	
Ileoappendicular	16	13	3	
Ileocolic	14	8	6	
Prevesical	13	3		10
Inferior duodenal	5	2	0	1
Great omentum	5	3	1	1
Ascending mesocolon	4	4	0	0
Miscellaneous	13	0	0	0
TOTAL	467	211	114	139

## REGIONAL DISTRIBUTION OF REPORTED HERNIA

REGION	NUMBER	PER CENT
Paraduodenal	50	53.0
Paracecal (pericecal) and terminal ileum	61	13.0
Terimesenteric	28	8.0
Foramen of Winslow	3	8.0
In the pelvis	21	7.0
In the sigmoid region	8	6.0
Miscellaneous	22	5.0

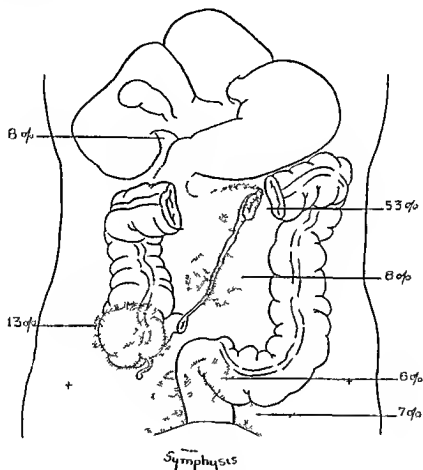


Fig. 1.—Regional distribution of internal hernia reported by Haenann and Morton

## Anatomy

**Paraduodenal Hernia**—This group constitutes nearly half of the reported cases of internal hernia. Duodenal hernia are designated by the name of the fossa in which they occur. Moynihan described nine fossae in which internal hernia may be found. The most important of these fossae are

- 1 The superior duodenal fossa (Eppinger)
- 2 The inferior duodenal fossa (Tretz)
- 3 The paraduodenal fossa (Landzert)
- 4 The mesentericoparietal fossa (Waldeyer)
- 5 The mesocolic fossa

The unimportant or rare fossae are

- 6 The posterior duodenal fossa (Gruber)
- 7 The duodenojejunal fossa (Huschke)
- 8 The recessus intermesocolicus transversus
- 9 The infraduodenal fossa

**1 Superior Duodenal Fossa**—The superior duodenal fossa is the upper part of the duodenojejunal fossa originally described by Treitz and it is present in 40 to 50 per cent of all subjects. It may exist alone although it is usually associated with an inferior duodenal fossa. The superior duodenal fossa lies to the left of the ascending position of the duodenum opposite the level of the second lumbar vertebra. This fossa is bounded above by the superior duodenal fold, which presents a semilunar margin that merges on the right into the peritoneum that covers the ascending duodenum, and on the left, with the peritoneum in front of the left kidney. The inferior mesenteric vein nearly always corresponds to the point of junction between the superior duodenal fold and the posterior parietal peritoneum. The fossa is usually about one inch (2.5 cm) deep, it often admits a third of the finger. Its orifice looks downward and it terminates in the angle formed by the left renal vein as it crosses the aorta.

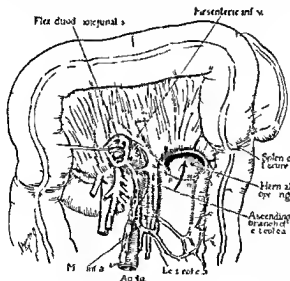


Fig. 200—The inferior duodenal fossa. This is the most constant of the duodenal fossae being present in 70 to 75 per cent of all cases.

**2 Inferior Duodenal Fossa**—The inferior duodenal fossa represents the duodenojejunal fossa described by Treitz. It is the most constant of the duodenal fossae, being present in 70 to 75 per cent of all subjects. It is situated on the left side of the ascending duodenum opposite the third lumbar vertebra. The orifice of the fossa is directed upward, and is bounded in front by a sharp margin of peritoneum—the inferior duodenal fold. When a superior duodenal fossa and an inferior duodenal fossa coexist they share a single orifice which

is generally oval in shape. There is often an extension of the fossa behind the ascending duodenum; this gives a large fossa that is particularly liable to become the site of hernia. (Fig 200)

**3 Paraduodenal Fossa**—The paraduodenal fossa was first described by Landzert in 1871. It is most frequently seen in the fetus or the newly born. It is situated on the left side, some distance from the ascending duodenum. It is a pocket formed by the fold of peritoneum and plica venosa which covers the inferior mesenteric vein and is most apparent when the colon is pulled strongly upward.

**4 Mesentericoparietal Fossa**—The mesentericoparietal fossa was described in 1874 by Waldeyer, who stated that the formation of this fossa is due to the raising up of a peritoneal fold by the superior mesenteric artery. This fossa is rarely found excepting in the fetus and the newly born. It is usually situated behind the superior mesenteric artery, just below the duodenum. It is possible that this variety of fossa accounts for some of the reported cases of hernia into the mesentery or through rents in the mesentery. Hudson reported a hernia of this type in an eight year old boy and its successful surgical management.

**5 Mesocolic Fossa**—The mesocolic fossa, which was described by Cooper in 1797, is rarely present. It is formed by the peritoneal fold that contains the ascending branch of the left colic artery; this fold is semilunar in shape and forms the anterior boundary of the fossa. The fossa lies to the left of the ascending duodenum and the inferior mesenteric vein, between the layers of the transverse mesocolon and extends to the left toward the splenic flexure of the colon.

**6 Posterior Duodenal Fossa (*Recessus Duodenojejunalis Posterior* of Broesike, the *Duodenojejunal Fossa* of Jonnesco)**—The posterior duodenal fossa was first described by Gruber in 1862. It lies behind the upper part of the ascending duodenum and is bounded behind by the parietal peritoneum that covers the lumbar vertebrae. The opening of the fossa is directed upward, slightly to the left, and is situated just above the duodenojejunal flexure. It is bounded on its side by two folds of peritoneum, the plicae duodenales superior of Broesike.

**7 Duodenojejunal Fossa**—The duodenojejunal fossa was first described by Husehke in 1844. This fossa is present in 15 to 20 per cent of subjects and is rarely or never associated with any other variety of duodenal fossa. It is exposed by pulling the transverse colon upward and by pulling the jejunum downward and to the right. The fossa appears as a circular opening directed downward and to the right and is bounded by two folds of peritoneum, the duodenomesocolic ligaments. The fossa is about 1 inch (2.5 cm) deep. It is bounded above by the pancreas, on the right by the aorta, on the left by the kidney, and below by the left renal vein.

**8 Intermesocolic Fossa**—The intermesocolic fossa was described by Broesike, who believed it is a modification of the duodenojejunal fossa. The



intermesocolic fossa is bounded by the transverse mesocolon and pancreas above, and below by the ascending duodenum and duodenojejunal flexure. The fossa is covered by a fold of peritoneum that extends between the under surface of the transverse mesocolon and the line of attachment of the mesojejenum.

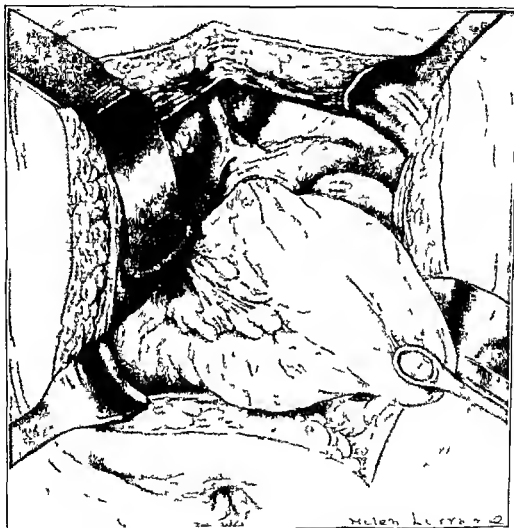


Fig. 201—Paraumbilical hernia—the most frequent variety

**9 Infraduodenal Fossa (Retroduodenal Fossa)**—The infraduodenal fossa was described by Jönnesco in 1893. It is bounded in front by the posterior aspect of the horizontal and ascending portions of the duodenum, behind by the aorta which projects into the fossa, and on both sides by folds of peritoneum—the duodenoparietal folds. The fossa is usually from 3 to 4 inches (7.5 to 10 cm) deep. Its orifice is directed downward and its apex often reaches to the pancreas and to the duodenojejunal angle.

**Clinical Varieties**—From a clinical standpoint duodenal hernias are named according to the side on which they occur. Left duodenal hernias are the most frequent of 70 cases collected from the literature by Moynihan 57 were on the left side. Hansmann and Morton in a review of the literature found 138 left paraduodenal hernia and 47 on the right side.

Left duodenal hernias nearly always occur in the paraduodenal fossa while right duodenal hernias almost always originate in the mesenterico parietal fossa (Fig 201).

**Size of the Hernia**—Duodenal hernias vary greatly in size. They may be no larger than a hen's egg or as large as an adult's head. The amount of intestine in the hernia may vary from a small knuckle in inch (2.5 cm) long as in the case reported by Broesike to the entire small intestine. Statistics show that as a rule the older the subject the larger the sac.

**Hernial Opening**—The opening of the sac is usually behind the hernia often very close to the lumbar vertebrae. In the small hernias the opening is usually to one side but as the tumor increases in size the opening changes to a position posterior to the hernia. The size of the opening varies it may be so small as to admit only a single finger or it may be large enough for the hand to enter the sac. In the cases collected from the literature by Moynihan the average size of the opening was 1 $\frac{1}{2}$  inches (4 cm) wide and 2 $\frac{1}{2}$  inches (6 cm) long.

**The Sac**—The hernial sac is formed by an invagination of parietal peritoneum.

**Omental**—Transomental hernia do not have a sac and the intestine passes through a congenital or acquired opening or slit in the omentum.

**Mesenteric**—Transmesenteric hernia only rarely have a sac and pass through a congenital or traumatic opening in the mesentery.

Hernia through the transverse mesocolon is very rare and only a few cases have been recorded. The condition is easily recognized at operation and presents no difficulties in treatment. When a hernia is found in the lesser peritoneal sac and the foramen of Winslow is patent the point of constriction should be looked for in the transverse mesocolon.

In 1600 autopsies reported by Mitchell holes were found in the mesentery in 3 subjects. In each case the opening was situated near the junction of the large and small intestines. In one subject a woman aged forty five years the opening measured 1 by 1 $\frac{7}{8}$  inches (2.5 by 4.75 cm). There was no hernia found in any of the subjects.

**Cecal Fossae**—There are four principal fossae in the cecal region namely the ileocolic, ileocecal, retrocecal and retroappendicular.

**1 Ileocolic Fossa** (*Anterior Ileocolic Fossa*—Jongnesco, *Superior Cecal Fossa*—Waldeyer, *Recessus Ileocecalis*—Broesike, *Ileocolic Fossa*—Lockwood and Rolleston). The ileocolic fossa was first described by Luschka in 1861. It is formed by the ileocolic fold of peritoneum arching over a branch of the ileocolic artery. The fossa is a narrow opening situated between the ileocolic

fold in front and the mesentery of the ileum behind. This fossa is developed best in children. It is reduced in size and is often absent in the aged and in the obese.

**2 Ileocecal Fossa** (*Ileoappendicular Fossa*—Jonnesco, *Inferior Ilcocecal Fossa*—Waldeyer, *Ileocecal Fossa*—Huschke) —The ileocecal fossa was first described by Huschke. It is bounded above by the posterior surface of the ileum and its adjacent mesentery, below by the ileocecal fold and behind by the upper part of the mesoappendix. This fossa is often well marked in the young, but is usually obliterated by deposits of fat in subjects of advanced years.

**3 Retrocecal Fossa** (*Fossa Cecalis*—Huschke, *Waldeyer*, *Subcecal Fossa*—Lockwood and Rolleston, *Retrocolic Fossa*—Treves, *Berry*, *Retrocecal Fossa*—Jonnesco) —The retrocecal fossa lies behind the cecum and is exposed best by lifting the cecum upward. The retrocecal fossa is bounded in front by the cecum, behind by the parietal peritoneum and on each side by the parietocolic folds. This fossa is sometimes deep enough to admit an entire finger.

**4 Retroappendicular Fossa** (*Recessus Retroappendicularis*—Leichtenstern) —The retroappendicular fossa was first described by Hartmann in 1870. It is a small depression between the mesentery of the appendix and the plica in fra angularis of Broesike—a peritoneal fold which sometimes extends from the ilocolic angle and the posterior and inner aspect of the cecum backward to the iliac fossa. The retroappendicular fossa is inconstant and of little surgical importance though Snow reported a case of hernia in this fossa.

**Paracecal (Pericecal)** —These hernias lie below the paraduodenal variety and pass into an open fossa in the cecal region. They may be in any one of the following: (1) *ileocecal*, (2) *ilocolic*, (3) *retrocecal*, (4) *retroappendicular*.

**Intersigmoid Fossa** —The intersigmoid fossa was first mentioned by Henning in 1742 and described by Haen in 1769. Roser in 1843 encountered this fossa and recognized it. Engel in 1857, studied it and asserted that it was obliterated in adults. Treitz thoroughly described it in 1857 and in 1868 Waldeyer described a double fossa.

The intersigmoid fossa lies between the sigmoid mesocolon and the parietal peritoneum. It is exposed best by drawing the sigmoid upward toward the left, the opening will be seen at the point of insertion of the sigmoid mesocolon. The intersigmoid fossa is present in a majority of subjects. Treves found it in 52 per cent of cases, Eccles in 53 per cent, Gruber in 60 per cent, Moynihan and Jonnesco in 70 per cent, and Waldeyer in 84 per cent. (The difference in percentage is largely due to the varying ages of the subjects.) In the fetus and newly born the fossa is nearly always present. It becomes less constant as age advances until after the fiftieth year when it is usually absent.

The opening of this fossa is round or oval and is bounded in front by a fold of peritoneum that contains the sigmoid vessels. The fossa lies behind the mesosigmoid and in front of the parietal peritoneum just above the inner margin of the psoas magnus muscle. The parietal peritoneum that forms the posterior wall of the fossa is adherent to the common iliac artery and overlies the ureter at the point where the ureter crosses the artery. The size of the fossa varies. It is often only a dimple, or it may be 2 to 3 inches (5 to 7.5 cm.) or

more deep. Sometimes it extends as high up as the body of the pancreas. The fossa is usually the size and shape of a finger cot for an average middle finger. Intersigmoid hernia is very rare, only a few cases have been recorded (Fig 202). Diagnosis has never been made before operation, and the treatment is the same as that for cecal hernia.

Intersigmoid hernias pass into one or two of the intersigmoid fossa, as these lie close together, on the lateral aspect of the mesentery of the sigmoid colon.

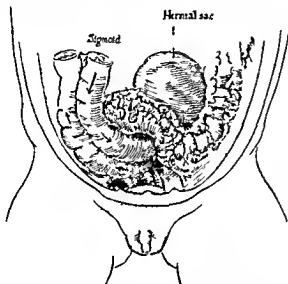


Fig. 202.—Hernia through the intersigmoid fossa.

**Hernia Through the Foramen of Winslow**—The foramen of Winslow is the opening between the greater and the lesser peritoneal sacs. It is bounded above by the caudate lobe of the liver, below by the duodenum and hepatic vessels, in front by the lesser omentum that contains the hepatic artery, portal vein and bile duct, and behind by the vena cava. The opening is directed forward and to the right. It is easily seen when the liver is lifted upward. It is usually about the size of a finger, but in adults and the aged it is often narrowed by inflammatory adhesions.

### Etiology

Many theories have been advanced to explain the cause of internal hernia—all the way from failure of the alimentary canal to rotate, to excessive rotation of the midgut in the embryo. Cogswell and Thomas have described this embryologic anatomy at length.

Another theory is that the hernia is the result of a congenital malformation which holds the small intestine beneath the mesentery of the developing colon.

Trauma also plays a role in the production of internal hernia in the form of gastrointestinal ulcers, newgrowths exerting pressure on the intestine, gall bladder calculi, injury or apertures the result of previous operations, emaciation, and obesity. Bird aptly sums up the question of etiology in a few succinct words: "the hernia must be congenital or acquired and lengthy discussion of theoretical causes is an academic fatuity."

**Paraduodenal Hernia**—Trentz stated that the following conditions are essential for the formation of paraduodenal hernia

- 1 The existence of a fossa and its peritoneal boundary fold
- 2 The presence of the inferior mesenteric vein in the fold
- 3 The freedom of movement of the small intestine to permit its entrance into the hernial sac

**Foramen of Winslow**—Hernia into the foramen of Winslow is rare. The predisposing causes are (1) a large foramen of Winslow, (2) an abnormally long mesentery, (3) excessive length or mobility of the intestine. There is no sac, and the hernia passes into the lesser peritoneal cavity.

**Sex**—Internal hernias occur in men four times as frequently as in women. Age has little or no relation to these hernias, as they occur from infancy to old age. Traumatic or postoperative hernias, as well as those associated with malignancy, usually are found in those patients who are middle aged or elderly. Pelvic hernia are nearly always in women.

**Sac Contents**—When the hernia has a sac, the usual content is small intestine, rarely the cecum, sigmoid colon, or other abdominal viscera. Sacless hernias are nearly always of the small intestine alone.

### Symptoms

The symptoms of nonstrangulated internal hernia are very indefinite and usually simulate digestive disorders. The most common symptom is that of partial or complete obstruction. In case of strangulation the symptoms are severe and are the same as those for other forms of acute intestinal obstruction. When considerable intestine is in the sac, abdominal distention is marked.

The tumor may be confined to a definite part of the abdomen. It is resonant on percussion, and frequently the loops of intestine can be seen in the mass.

In left paraduodenal hernia the inferior mesenteric vein is subjected to pressure from the hernia, and this often results in congestion and dilatation of the hemorrhoidal veins sometimes with hemorrhage. Sometimes the pain of internal nonstrangulated hernia is relieved by lying down and aggravated by exercise or the upright position. Johns places stress on the pain syndrome, and when the pain however severe, is relieved by lying down, an internal hernia should be suspected.

In cecal hernia, abdominal symptoms are often absent and not infrequently in these patients a diagnosis of appendicitis is made before operation. In hernia into the foramen of Winslow, symptoms of acute intestinal obstruction appear suddenly, with pain localized in the epigastric region that is more severe than in ordinary cases of intestinal obstruction. There is often a tumor in the epigastric region that is resonant to percussion.

### Diagnosis

The most frequent symptom of internal hernia is partial or complete intestinal obstruction. Preoperative diagnosis was seldom made prior to the perfection of roentgen ray examination, but now a preoperative diagnosis is sometimes made.

McCarty and Present emphasize the value of roentgen ray studies with the "small bowel" technique in making a preoperative diagnosis for all patients not in need of immediate operation. Lahey and Trevor also believe a preoperative diagnosis is possible by means of roentgen ray studies.

Except in the hands of a skilled roentgenologist, a preoperative diagnosis is still uncertain or impossible. A roentgen ray diagnosis is sometimes possible when the intestines are crowded together as in a transparent bag and their position is not altered by a change in posture. There is dilatation, stasis, and loss of motility; the intestines are in a high position; there is a dilatation of a portion of the small intestine or colon in an abnormal location with symptoms of intestinal obstruction.

Tagarasani reports the case of a man operated on for duodenal occlusion in which the symptoms were found to be due to a retroduodenal hernia. Atherton's patient was operated on for what was thought to be chronic appendicitis. Arnold reported a case in which the obstruction of a paraduodenal hernia was due to a large biliary calculus. Cogswell and Thomas found tuberculosis as the cause of adhesions that produced strangulation of a paraduodenal hernia. Saffa and Biude observed an incarcerated paraduodenal hernia that was complicated by left-sided appendicitis. Bastrocchi found a strangulation of an inflamed appendix through an aperture in the omentum.

### Prognosis

The prognosis is always serious for internal hernia. The mortality rate is about 50 per cent. This is accounted for by the problem of diagnosis, the delay in operation, the difficulty in freeing intestine, and shock and infection especially if the hernia is in the upper abdomen. Operations for hernia through the foramen of Winslow have the highest mortality rate of all.

### Strangulation

Small intestine is nearly always the sole viscus strangulated rarely omentum slips through. Masson and Atkinson found a strangulated ovary and tube.

### Treatment

Internal hernia is seldom diagnosed except at operation undertaken for symptoms thought to be those of ordinary intestinal obstruction. The hernia is discovered while searching for the strangulation. In operating for paraduodenal hernia the inferior mesenteric vein must never be divided under any circumstances. When resection is not required the strangulated loop of intestine should be gently pulled into the general abdominal cavity, and the aperture or fossa should be obliterated with silk or cotton sutures, which should be buttressed by omentum, or near by mesentery. It is an additional safeguard to tuck a coil of intestine over the sutured hernial wound, if such a procedure is feasible.

It is well to bear in mind during an exploratory operation for intestinal obstruction, or possible internal hernia that the manipulation of the intestines

or a mild pull may liberate a loop incarcerated in an internal fossa, and thus the hernia is never discovered

**Postoperative Treatment**—The general care is the same as for other hernias, except that in these patients the diet is most important. As soon as fluids can be taken by mouth they should be gradually increased, and after three to five days a residue free diet should be employed. A soft diet can be given on the sixth or seventh day, and a general diet in two weeks. Gas distention should be prevented by using the Wangenstein suction tube and a low rectal tube or catheter. Intravenously, 10 per cent glucose and physiological normal saline are indicated. The water and chloride balance must be maintained both before and after operation, and vitamin C for wound healing should be given.

Ileus following peritonitis calls for a sedative to quiet peristalsis, while ileus due to intestinal paralysis should be stimulated by proglutinin or antitritin and, as a final resort, novocaine or procaine spinal anesthesia.

### Postoperative Complications

Postoperative complications are frequent and are usually serious.

Harries reported an internal hernia following an operation for posterior gastrojejunostomy. There were no symptoms of the hernia except hiccups on the day after operation. On the third day the wound opened, and at reoperation the hernia was discovered and the surgeon was surprised to find that all of the catgut sutures had been absorbed.

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## CHAPTER XXVI

### LUMBAR HERNIA

**Synonyms**—Hernia dorsalis, Petit's hernia, Grynfeltt's hernia, hernie costaliaca de Lauey, hernie supraduodenale de Hugnier

A lumbar hernia may appear anywhere in the lumbar region, which is bounded above by the twelfth rib, below by the crest of the ilium, in front, by a line drawn vertically downward from the anterior extremity of the twelfth rib to the crest of the ilium, and behind by the vertebral column and the erector spinae muscles

Lumbar hernia may be congenital or acquired, and the acquired form may be spontaneous (nontraumatic) or traumatic

#### Historical

The possibility of hernia occurring in the lumbar region was first suggested by Barbette in 1672. Blauvard in 1701 and Dolé in 1703 knew of lumbar hernia, but their writings, as well as those of Renaudine de Lagatienne in 1726, contain no record of a case. In 1728 Budgen described a case of congenital lumbar hernia but it is evident he did not know what it was. The first authentic case was observed and recorded in 1731 by DeGarengeot, who reduced the hernia after death. In 1738 a case of strangulated hernia, through the triangle that bears his name, was described by Petit. In 1750 Ravaton published the first report of a patient with strangulated lumbar hernia who survived operation. Until 1866 when Grynfeltt described the superior lumbar triangle, lumbar and ventral hernia were frequently confused and all lumbar hernias were supposed to come through Petit's triangle—the inferior lumbar triangle. In 1767 Heuermann described a case of strangulated hernia which was cured spontaneously by the formation of an artificial anus. Balm in 1768, described a lumbar hernia making its exit above the ilium and behind the external oblique.

In 1923, I collected 115 cases of lumbar hernia from the literature. Virgilio in 1925, published a comprehensive review of the subject. Kananka in 1934, discussed the etiology of lumbar hernia. Sias in 1937, reviewed the literature to that date. In 1939, Kelton reported a postoperative lumbar hernia. Cuervo, in 1940, wrote on the anatomy of lumbar hernia. Sibilla in 1941, published an extensive review of postoperative lumbar hernia. In 1942 Pavlovich and Taya reported an unusual case of double hernia in Petit's triangle. Calisti in 1943, published an interesting study of lumbar hernia, and Kapsinow reported a hernia that developed after the strain of heavy lifting. In 1944, Stubenbord also reported a case that followed lifting. Yazlle wrote on the diagnosis of lumbar hernia, and Fresno Albarrán published a review of the operative techniques and a description of his excellent operation for lumbar hernia. Campbell, in 1947, reported two cases.

#### Statistics

In 1946 I collected from the literature 186 cases of lumbar hernia.

**Sex**—The sex was given in 142. Of these 103 were males and 39 females.

**Age.**—The age was given in 141 as follows:

Under 1 year	2
Under 2 years	0
2 to 10 years	16
11 to 20 years	14
21 to 30 years	10
31 to 40 years	14
41 to 50 years	11
51 to 60 years	10
61 to 70 years	25
71 to 80 years	3
Adult	13
Old	5
	<hr/> 141

**Side Involved and Point of Exit**—The side involved or the point of exit of the hernia, or both, were given in 157 cases as follows:

PETIT'S TRIANGLE				CRYNFEIT IFFSHAFT TRIANGLE				TRIANGLE NOT STATED		
R.	L.	BILATERAL	SIDE NOT GIVEN	R.	L.	BILATERAL	SIDE NOT GIVEN	R.	L.	BILATERAL
13	24	1	15	11	19	2	15	5	31	21

**Varieties of Lumbar Hernia**—Lumbar hernia is usually classified according to its etiology into three varieties—congenital, nontraumatic, and acquired traumatic. In the 186 cases, including my own, the cause was noted in 135 as follows:

Congenital		20
	fall	10
	strain	10
Nontraumatic	lifting	4
	injury	4
	"spontaneous"	42
Acquired traumatic	abscess of lung	1
	abscess of spine or scoliosis	25
	postoperative	7
Cause unknown		12
Total		<hr/> 135

#### Nontraumatic Lumbar Hernia—

**Sex**—In 65 cases of nontraumatic hernia, there were 42 males and 18 females. In 17 the age was not given.

**Age**—The ages in 83 patients were as follows:

Under 2 years	3
2 to 10 years	3
11 to 20 years	4
21 to 30 years	6
31 to 40 years	7
41 to 50 years	9
51 to 60 years	13
61 to 70 years	19
71 to 80 years	2
Adult	11
Old	6
	<hr/> 83

*Side Involved and Point of Exit*—In 68 patients with nontraumatic lumbar hernia it appeared in Petit's triangle or the Grynfeltt Lesshaft triangle as follows

PETIT'S TRIANGLE				GRYNFELTT LESSHAFT TRIANGLE			
R	L	BILATERAL	SIDE NOT GIVEN	P	L	BILATERAL	SIDE NOT GIVEN
8	17	1	5	10	16	2	9

**Strangulation**—Strangulation was present in 15 cases (9 per cent)

**Treatment**—The treatment and result were given in 73 cases as follows

	RECOVERED	DIED
Hernia reduced	25	0
Hernia treated by operation	44	1
Hernia incised in mistake for abscess	1	0
Strangulation with spontaneous rupture	1	0
Strangulated untreated	0	1

### Anatomy

**Course of Lumbar Hernia**—The lumbar region presents several weak points through which the abdominal contents can escape. The two usual openings are the inferior lumbar, or the triangle of Petit, and the superior lumbar triangle, or Grynfeltt Lesshaft space. The abnormal openings in the muscles and aponeurosis may appear anywhere in the lumbar region, and are either congenital or acquired (Fig 203)

Various investigators have described different places as the weakest, and hence the most likely point of outlet for a lumbar hernia.

There is considerable controversy as to whether lumbar hernia makes its exit through the inferior lumbar triangle or the superior lumbar triangle. The general opinion among recent investigators is that most of these hernias appear primarily in the superior lumbar triangle.

**1 Inferior Lumbar Triangle** or triangle of Petit. The inferior lumbar triangle is bounded in front by the external oblique, behind by the anterior border of the latissimus dorsi, and below by the crest of the ilium. The floor is covered by the heavy lumbar fascia, beneath this are the muscular fibers of the internal oblique, and deeper still, the aponeurosis of the transversalis abdominis. In some cases the internal oblique at this point is wholly tendinous.

The dimensions of Petit's triangle are variable. It may be merely a slit between the muscles, with a base measuring 5 to 8 mm (Rochard), or 1 cm (Charpy) or larger, with a base measuring 4 cm (Luschka) to 5 to 6 cm. The height of the triangle is usually 1 to 7 cm.

The existence of Petit's triangle is not constant, but it is found more frequently in adults than in children. It is not present in very muscular subjects because the latissimus dorsi is overlapped by the external oblique muscle. Lesshaft examined 108 adult and 35 infant cadavers, and found it in 77 per cent of the adults, and in 25 per cent of the infants. Charpy found it in 77 of 100 cases examined. Goodman and Speese in 76 examinations found it in 63½ per cent of the cases.

2 *Superior Lumbar Triangle*—(Grynfeltt Lesshaft space lumbo-costo-abdominal triangle of Grynfeltt, or spatium tendineum lumbale of Béraez, or the rhombus of Lesshaft) Grynfeltt in 1856 and Lesshaft in 1870 demonstrated a second opening through which a hernia could occur. The base of this triangle is above, and is bounded by the twelfth rib and the lower border of the serratus posterior inferior in front by the posterior border of the internal oblique, and behind by the anterior border of the erector spinae. This triangle is in front of Petit's triangle and above it. It is covered by the latissimus dorsi muscle and the floor is formed by the aponeurosis of the transversalis.

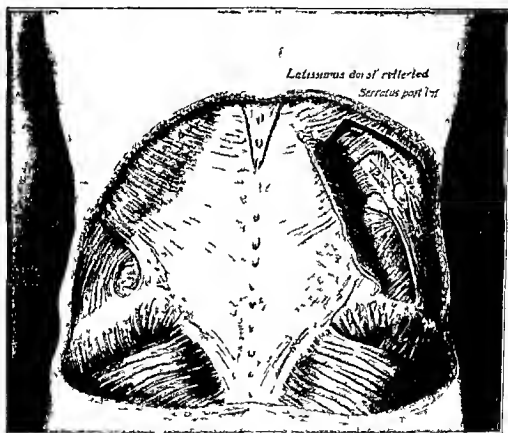


Fig. 27.—The anatomy of lumbar hernia. On the left Petit's triangle. On the right the superior lumbar triangle of Grynfeltt-Lesshaft.

The superior lumbar triangle sometimes takes the form of a quadrilateral or it may be deltoid, trapezoid or polyhedral. The size and the shape of the space depend upon the development of the serratus posterior inferior, the attachment of the external oblique to the last rib, the length of the twelfth rib, the space between the internal oblique and the lateral border of the erector spinae, the attachment of the latissimus dorsi to the eleventh or twelfth rib or its union with the posterior fibers of the external oblique, the development of the quadratus lumborum and internal oblique muscles. The weakest spot is in the upper

part of the space a little below the twelfth rib, where the aponeurosis of the transversalis is not covered by the external oblique muscle. The twelfth intercostal nerve accompanied by its artery and vein penetrates at this point.

The superior lumbar triangle is more constant, and is larger than Petit's triangle, it is found more frequently in adults than in infants and children. Barbe found it in 50 per cent of 100 examinations. Baracz and Buzynski found it in 71 out of 76 cadavers examined or 93 per cent. Goodman and Speece in 76 examinations found it in 93½ per cent of the cases.

**3 Irregular Openings in the Muscles and Aponeurosis.**—In addition to the superior and inferior lumbar triangles there are other points in this region through which a hernia may emerge. Slits or buttonhole openings in the aponeurosis the result of trauma or maldevelopment may give passage to small fatty hernias (Morestin). Braun believed that lumbar hernia could escape through the apertures for the cutaneous branches of the second and third pairs of posterior lumbar nerves. (Cooper advanced the same opinion as a cause of ventral hernia.) This theory was denied by Macerady who pointed out that the nerves run between the muscles and do not penetrate the whole thickness of the parietes at any one point.

**Frequency of the Varieties of Lumbar Hernia.**—I collected 123 cases in which the variety was given. In 53 of these the hernia emerged through the inferior lumbar triangle and in 47 it appeared through the superior lumbar triangle.

I found 20 cases of congenital lumbar hernia, 70 of nontraumatic hernia and 33 of required traumatic hernia following injury or disease. (No effort was made to collect the last named variety many more cases are reported in the literature.)

The most frequent locations of the lumbar hernias I collected were the two principal triangles, but in some instances the hernia forced its way through at some other point namely through a congenital opening in the abdominal wall through an opening in the latusmus dorsi through the external oblique internal oblique and transversalis through an opening, following necrosis of the iliac crest and through the cicatrix of a wound.

**The Sac.**—Large hernias are usually silentaneous while small ones are sometimes separated from the skin by a layer of fat or muscle the most frequent covering being either the external or the internal oblique muscle. There is usually a sac. There are also instances in which there is none. This hernia which is really a subperitoneal lipoma is surrounded by a peritoneal cul-de-sac, a condition that is similar from a pathologic point of view to a condition we find in extraperitoneal femoral and bladder hernias. The only lumbar hernia of abdominal viscera that is nearly always without a sac is hernia of the kidney this is due to the situation of the kidney underneath the peritoneum.

**Contents of the Sac.**—The sac most frequently contains omentum sometimes fat mesentery large or small intestine appendix stomach cecum sigmoid and in rare instances the kidney. Plenck in 1774 reported a congenital hernia of the kidney. In 1811 Monro saw a case of bilateral congenital lumbar

hernia with the kidneys entirely within the sac, in an infant six months old Bryer observed a case in which the contents of the sac consisted of the small intestine, the ascending colon, and the right kidney. Because of anatomical conditions the intestine does not appear in the sac of lumbar hernia as frequently as it does in other abdominal hernias. For this reason, lumbar hernias are frequently epiploceles or fatty hernias. Fatty hernias without sacs were described by Marmisse in 1862.

### Etiology

The two varieties of lumbar hernia to be considered are congenital and acquired.

**Congenital Lumbar Hernia**—A congenital hernia is one that is present at birth, and is due to malformation or to arrested or deficient development of muscles, aponeurosis vertebrae lumborum or the lower ribs. Any defect that weakens the resistance of the lateral abdominal wall may be the causative factor. This type of hernia is often bilateral and may be associated with other developmental anomalies.

There are only a few cases of congenital lumbar hernia on record. Brachardt reported a case in an infant of fifteen months in which the hernia filled the entire space between the twelfth rib and the crest of the ilium. Wyss saw a case in which the posterior serration of the external oblique and the posterior half of the transversalis were deficient. The hernia was very large and came through the superior lumbar triangle. Dowd saw a case in a child aged three and one half years, in which the hernia was the size of a goose egg. Two years later, in spite of an elastic belt having been worn, the hernia had grown to the size of a man's fist. Grange, in 1896, found 5 congenital hernias in 45 cases collected from the literature. Jernnel in 1902, was able to find 10 additional cases, and I have since collected 8 more.

**Acquired Lumbar Hernia**—Acquired lumbar hernia usually occurs in adults, it may be on either side, is very rarely bilateral, and is much more frequent than the congenital variety. Hernias due to effort, strain or to trophic changes in the muscles, such as atrophy following acute anterior poliomyelitis appear in the superior or inferior lumbar triangles, while traumatic hernias due to direct injury and disease may appear anywhere. *Acquired lumbar hernia may be either spontaneous or traumatic.*

**SPONTANEOUS LUMBAR HERNIA**—Spontaneous lumbar hernia may appear any time after birth, but is most frequently seen in middle and old age. It is generally believed that this variety of lumbar hernia is due to a congenital predisposition, supplemented by indirect injury, strains, such as lifting and coughing. Other causes that may predispose to the development of a spontaneous hernia are obesity, emaciation, old age, chronic bronchitis, emphysema and laborious occupations. In rare instances no causative factor can be found.

In 70 cases of spontaneous acquired (nontraumatic) lumbar hernia that I collected from the literature 42 were in males and 18 in females. In 10 the sex was not given.

*Age*—The age was given in 55 patients as follows

Under 2 years	1
2 to 10 years	2
11 to 20 years	2
21 to 30 years	4
31 to 40 years	3
41 to 50 years	7
51 to 60 years	10
61 to 70 years	13
71 to 80 years	1
Adult	7
Old	5
	<hr/> 55

**TRAUMATIC HERNIA**—Traumatic hernia is sometimes called accidental or occasional postoperative or eietrical. True traumatic hernia is caused by direct injury such as a severe crushing blow or a fall from a height. Hancock reported a case of traumatic hernia through Petit's triangle in a man which was caused by his being thrown from the top of a railroad car that had been derailed. Rishmiller reported a case of traumatic hernia in Petit's triangle in a man who was crushed over both thighs by a car wheel and a piece of bone was broken off the crest of the left ilium.

**Operative**—Postoperative hernia may occur when the wound closure has been faulty or when primary healing is delayed as sometimes occurs after operations for the suppurative diseases of the kidney.

**Abscess**—Pott's disease or caries of the vertebrae is the most frequent cause of acquired lumbar hernia. The hernia may also follow a deep abscess due to osteitis of the ribs or pelvic bones which has come to the surface through a weak point in the lumbar region. The lumbar abscess may also originate in the liver, intestines or other viscera or follow the breaking down of an old hematoma.

### Symptoms and Diagnosis

**Reducible Hernia**—As a rule, reducible lumbar hernia is simple to diagnose. It may vary in size from a small tumor an inch (2.5 cm.) or less in diameter to one that measures a foot (30 cm.) across. When the tumor is small it is easy to locate and if it is excessively large it may pass out beyond the confines of the lumbar ring and lie over on the side of the abdominal wall. It is usually hemispherical in shape but is sometimes ovoid. The size and the shape are variable depending on the posture of the patient and whether he is in a state of repose or exertion. The impulse from coughing is plainly felt and a resonant or tympanic note is heard on percussion. The tumor is soft and reduces easily usually with a gurgling sound (Fig. 204). Congenital hernias are noticed at birth or soon after and are soft, increasing in size when the child cries.

There are no very marked subjective or functional symptoms. In some cases there is a feeling of fatigue on exertion, pain in the back, colic with vomiting, tenderness on pressure and a dragging sensation of weight which disappears when the hernia is reduced. A lumbar hernia develops very slowly, sometimes being of considerable size before the patient is aware of it.



The diagnosis of fatty hernia is often difficult. When reduced it may appear to be an enterocele and when adherent and irreducible it may sometimes be mistaken for an obstructed or strangulated hernia. The lumbar hernias that are most difficult to diagnose are those that are irreducible or strangulated (Fig. 205.)



Fig. 205.—Lumbar hernia through Petit's triangle.

**Strangulated Hernia**—Because of the large size of the ring and neck of the sac strangulation by constriction in lumbar hernia is almost impossible though it does occur occasionally. I collected from the literature 186 cases of

lumbar hernia due to all causes and found strangulation in 15 (80 per cent). In these 15 cases reduction was effected by taxis in 5 and operation was performed in 4. Rivaton's patient recovered after incision in spite of the usual postoperative evisceration and serious septic peritonitis of preantiseptic days. Hume's patient showed a gangrenous small intestine caused by the pressure of two fibrous bands and a twisted sigmoid. Intestinal resection was done but the patient died with peritonitis in twenty-four hours. Lejars' patient had strangulation of the ascending colon and recovered after operation. One patient in this group of 15 died without any curative measures being attempted and there are no details given regarding 4 cases.

Spontaneous hernia is more frequently strangulated than other varieties. Of 70 cases I collected 18 per cent were strangulated. The most frequent cause of strangulation is a constriction of the neck of the sac or a volvulus.



Fig. 205.—Spontaneous left lumbar hernia in a man aged fifty-two years. The swelling first appeared after a strain two years before examination. The tumor has gradually increased in size and there is a slight impulse on coughing. The mass consists mostly of fat and probably comes through the superior lumbar triangle. A bandage was applied; operative treatment being refused.

**Differential Diagnosis**—Lumbar hernia must be diagnosed from the following conditions:

**Abscess**—The pointing of an abscess in the lumbar region is favored by the natural weakness of the lumbar triangles, which are the thinnest points in the lateral and posterior regions of the abdominal wall. As a rule an abscess gives a history of Pott's disease or other bone involvement; it is soft and fluctuating and is not completely reducible. When it is emptied by pressure another bulge usually appears nearby, which is the pocket into which the pus has been forced.

When the abscess is intramuscular and very voluminous, the fluctuation is difficult to detect. Several cases have been reported in which a lumbar hernia has been mistaken for an abscess and incised, resulting in a fecal fistula, which usually closed in time, if no complications developed.

*Lipoma*—As a rule, the diagnosis of lipoma is simple, with little chance of making a mistake. This tumor is of very slow growth, and can usually be lifted free from the surrounding muscles. There are no subjective symptoms.

*Fibroma*—A fibroma usually involves the muscle tissue, and while it is not so freely movable as a lipoma, the typical symptoms of hernia are lacking. It is ordinarily impossible to differentiate fibroma from lipoma until operation.

*Muscle Hernia*—A muscle hernia does not reduce, so to speak. It disappears, leaving no hernial orifice that can be felt by the finger.

*Hematoma*—Hematoma usually gives a history of trauma, or it may be postoperative.

In all these conditions the subjective symptoms of intestinal obstruction or strangulation are absent, and the most striking sign of nonstrangulated hernia is lacking, viz., a reducible swelling that gives an impulse on coughing, leaving a definable ring on reduction.

### Prognosis

The prognosis for lumbar hernia is usually favorable. Strangulation is not so frequent as in other varieties. In over half of the strangulated cases reported, reduction has been accomplished by taxis, which was possible because of the large opening and the frequent absence of a sac.

The radical operation is the treatment of choice for children. The results of bandage or truss treatment are unsatisfactory because the hernia tends to increase in size as the child grows and it is difficult to keep the truss in place. In patients past middle life, a small lumbar hernia causes little inconvenience and a truss is often fairly comfortable, as the active movements of the elderly are naturally restricted and accomplished with little muscular effort.

### Treatment

**1 Mechanical**—Lumbar hernia is nearly always reducible and can some times be controlled by a truss or bandage. Mechanical treatment is usually unsatisfactory as the hernia increases in size in spite of it, especially in children.

**2 Radical Operation**—When there is a choice of treatment, and there is no contraindication in the age or health of the patient, the operation should always be done. The same general principles apply in operating on lumbar hernia as in other hernias.

*a Incision*—The incision is usually made over the center of the tumor, beginning just below the twelfth rib and extending downward to the iliac crest. It should be long enough to give a free exposure so that all bleeding points can be seen easily and caught with pressure forceps. Because of the thinning of the tissues, there is less hemorrhage than in the ordinary operation for exposing the kidney.

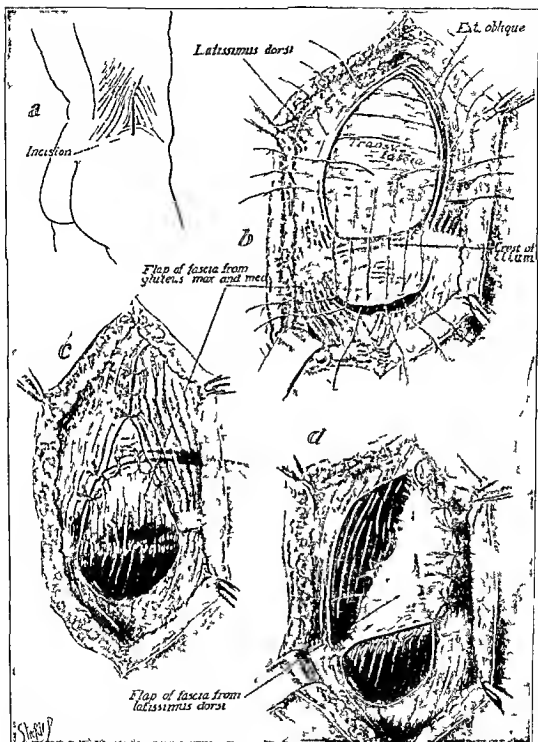


Fig 200—Dowd's operation for lumbar hernia. (a) The line of incision. (b) Turning up a flap of fascia lata and sponerosis of gluteus maximus and medius muscles and suturing it to the lumbar fascia external oblique and latissimus dorsi muscles. (c) The flap sutured. (d) Closing the remaining gap with a flap of fascia from the latissimus dorsi.

*b. The Sac.*—The sac is never adherent to the skin. In large hernias it may be near the surface, but, as a rule, it is covered by fat, and rarely by muscle. If it is not readily found, the dissection should proceed very cautiously, as in many cases there is no sac, and only a mass of subperitoneal fat which may represent the mesocolon is in its place. It is well to remember the experience of Turner, who found the colon immediately beneath the subperitoneal fat, and tore the outer coat in his search for a sac that did not exist. The posterior part of the colon was not covered by peritoneum, and it had evidently become loosened from its attachments by the protrusion and retraction through the hernia opening, which accounted for the cavity felt at examination.

*c Fatty Hernia*—When the hernia consists only of a mass of subperitoneal fat, the pedicle is ligated, the tumor excised, the edges of the aponeurosis are overlapped, and the opening closed with interrupted or mattress sutures of silk or cotton.

*d. Closing the Hernial Opening*—Small hernial openings can be closed with a purse-string suture and an overlapping of the fascia, as is done with small ventral hernias. It is sufficient to invert the sac without removing it, while in large hernias, it is best to resect the sac.

**Large Hernial Openings.**—Because small lumbar hernia is not troublesome, patients do not often seek treatment until the hernia is large, when it

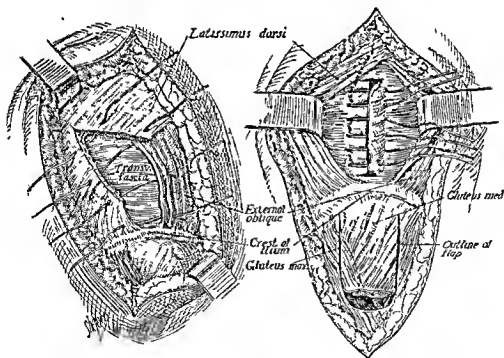


Fig. 207

Fig. 208

Operation for lumbar hernia.

Fig. 207—Rishroll's method of closing the opening by a flap obtained by splitting the latissimus dorsi and overlapping the superficial fascia.

Fig. 208—Closing the opening by overlapping flaps of transversalis fascia, and reinforcing the suture line with a flap turned up from the fascia below the crest of the ilium.

has become difficult to bring the muscular and fascial layers together over the orifice of the hernia. Often it is possible to detach a portion of the latissimus dorsi or external oblique muscle, and bring it over the opening and suture it. Owen, in 1888, was the first to excise the sac and close the wound with buried sutures. Bull overlapped the muscle and fascia, using kangaroo tendon.

Dowd first turned up a flap made of fascia lata and the aponeurosis which overlies the gluteus maximus and medius. This flap was sutured to the lumbar fascia, the external oblique and latissimus dorsi muscles. The opening still remaining at the upper part of the wound was narrowed still more by suturing together the edges of the external oblique and the latissimus dorsi muscles. These last sutures were further reinforced by a flap from the aponeurosis of the latissimus dorsi muscle which was turned forward and sutured to the aponeurosis of the external oblique. The patient had no recurrence (Fig 206).

Rishmiller closed the opening with a flap made by splitting the anterior border of the aponeurosis of the latissimus dorsi. The crest of the ilium was roughened in order to favor soft tissue attachment. Interrupted sutures were used to approximate the internal oblique to the inner split half of the aponeurosis of the latissimus dorsi. A flap made from the outer split half of the aponeurosis of the latissimus dorsi was turned over the unenclosed arched area just above the ilium and sutured. The superficial fascia was overlapped double breasted fashion. Primary union resulted and there was no recurrence.

An excellent method is to overlap freely the flaps of the transversalis fascia. Longer flaps can be secured by crossing the flap incision at either end by short transverse incisions. If the gap is large a flap of fascia is turned up from below the crest of the ilium. The muscles are brought together and the superficial fascia is sutured (Figs 207 and 208).

**Strangulated Lumbar Hernia**—Operation should be done immediately without attempting taxis. The hernia should be well exposed and dealt with as in strangulation elsewhere.

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## CHAPTER XXVII

### OBTURATOR HERNIA

**Synonyms**—*Hernia foraminis ovalis* (de Garengot), *hernie sous pubienne*, anterior iliac hernia (Hesselbach), thyroidal hernia (Cooper), opeocele

**Definition**—An obturator hernia is one that passes through the obturator foramen or canal in the os innominatum

#### Historical

The first case of obturator hernia was observed by Arnaud de Ronsil, in 1724, and reported to the Royal Academy of Sciences in Paris. The members denied the existence of such a hernia and refused to approve his findings. Two years later Duverney found a case of double obturator hernia in the pelvis of a woman that he had dissected, each sac contained intestine, and the tumor was the size of an egg. According to Heenel, obturator hernia was described by Le Maire in 1718, and was demonstrated in Berlin in 1734 by Cassebohm. However, de Garengot was the first to make a thorough study of this subject. In 1743 he read a paper before the Royal Academy of Surgery in Paris, reporting a case he had observed in 1733, and six others collected from the literature. Caupér described the anatomy of this variety of hernia in 1762, and noted the tendency of the peritoneum to form a diverticulum in the obturator foramen.

In 1768 G. Arnaud, the son of Arnaud de Ronsil, reported a case of strangulated obturator hernia in which he succeeded in reducing the intestine by taxis, only a small lump remaining irreducible. This was the first patient successfully operated on. In 1744 Gunz saw an obturator hernia of the bladder. Dupuytren, in 1819, diagnosed an obturator hernia, reduced it, and the patient recovered.

Laparotomy for strangulated obturator hernia was first used by Hilton in 1848, by Conlson in 1863, and by Godlee in 1885. Their patients died, and the operation fell into temporary disrepute.

Because of the usual absence of a tumor, obturator hernia has always been misleading, and until recent years, diagnosis was practically never made except in case of strangulation or at autopsy. A majority of the cases of strangulated hernia were diagnosed during the course of operations for intestinal obstruction.

Engelsch, in 1891, was able to collect from the literature 135 cases of obturator hernia. Jaboulay and Patel in 1889 found 35 additional cases. In 1909 Corner and Huggins stated that the total number of cases reported exceeded 250. In the last few years, several cases have been diagnosed without opera-



tion, and the number of cases reported is increasing each year, so that the condition is no longer considered a rarity

Meyer, in 1914, wrote that with advent of the antiseptic surgery there were as many strangulated obturator hernias cured in the ten years following 1875 as were treated in the hundred and fifty years preceding. Mulligan, and Kinderscherf, in 1919, advocated the inguinal route for uncomplicated obturator hernia. Canavero reported his anatomical studies, and Roche his research on strangulated hernia, in 1930. Engberg, in 1932, published an excellent paper with case reports. Cottalorda and Escarras outlined the various operative measures for obturator hernia, and Cordier, Coulouma, van Varseveld, and Dauchy published their paper on the anatomy of obturator hernia, in 1936. Wakeley, in 1939, reported 2 cases and presented an outstanding and comprehensive treatise on the subject. Ludwig, in 1941, reported a successful operation on a woman 102 years old, for strangulated obturator hernia. Bishop, Anson and Ashley, in 1942, in a study of the obturator region, found 5 preperitoneal lipomatous structures in 132 body halves. Saleeby, in 1944, reported a successful operation for strangulated obturator hernia on a woman eighty three years of age. Every month or so for two years she experienced the pain of the Howship Romberg syndrome. Van Meurs, in 1945, recorded a rare case of strangulation of the ovary and tube in an obturator hernia. Albanese, in 1945, reported a case and wrote at length on the difficulties of diagnosis. Pernworth, in 1946, observed a patient with obturator hernia and discussed the treatment of strangulation.

In the last few years many cases have been diagnosed before operation, and the number reported is increasing each year, so that the condition is no longer considered a rarity.

### Statistics

In 1946, I collected from the literature 442 cases of obturator hernia.

**Age**—In 299 cases, the ages of the patients were given as follows:

Under 10 years	0
11 to 20 years	3
21 to 30 years	10
31 to 40 years	21
41 to 50 years	33
51 to 60 years	58
61 to 70 years	96
71 to 80 years	62
81 to 90 years	14
Over 100 years	1
Adult	1

299

**Sex and Site**—In 338 cases, the sex, or the site of the hernia, or both, were given as follows:

NO CASES	MALES				FEMALES				SEX NOT GIVEN	
	R	L	BILAT ERAI	SIDE NOT GIVEN	R	L	BILAT FRAL	SIDE NOT GIVEN	R	L
338	18	20	5	9	14	104	17	31	5	5

**Duration of Strangulation**—In 193 cases, the duration of the strangulation was given, that is, the amount of time that passed before the patient was relieved by taxis or operation, or before death:

1 day	16
2 days	15
3 days	31
4 days	30
5 days	22
6 days	16
7 days	12
8 days	21
9 days	5
10 days	6
11 days	3
12 days	2
13 days	0
14 days	6
15 days	4
16 days	1
21 days	2
28 days	1
	<hr/>
	193

**Sac Contents**—In 125 cases the sac contained the small intestine, and in 37 cases the large intestine. Among the viscera found in the sac were the ileum, jejunum, colon, sigmoid, cecum, appendix, omentum, bladder, ovary, fallopian tube, and uterus. In one hernia there was a volvulus of the small intestine of 360 degrees, and in another case, one of 180 degrees. In one case of hernia of the colon there was a 300 degree torsion of the colon in the abdomen, above the neck of the sac.

**Diagnosis**—Of the 230 patients who were treated by operation or who died of strangulation without operation, a diagnosis previous to operation or autopsy was made in only 53.

**Howship-Romberg Sign**—The Howship Romberg sign was noted in 68 cases. In many of these, the diagnosis was not made even with this characteristic sign present.

**Results of Treatment**—In this series of 427 cases the final results were given in 269 as follows:

Operation followed by recovery	109
Operation followed by death	79
Death, no operation	81

In 64 patients reported between 1900 and 1923, three died of strangulation without operation, 61 were operated on, and of these 23 died (37.7 per cent) and 38 recovered (62.3 per cent).

In 12 cases the first operation was done for a supposed strangulation of an inguinal or femoral hernia or intestinal obstruction, and a second operation was done later, with the result that 11 of these patients died and one survived.

### Anatomy

The obturator foramen is covered by an aponeurosis of interlacing fibers called "the internal obturator membrane," which is attached externally to the



membrane, reenforced by the obturator muscle, and its anterior wall is formed by the external obturator membrane and muscle. This anterior wall may present several orifices in the fascia or muscle through which a hernia may make its exit.

The internal orifice is formed above, by the bony margin of the ascending ramus of the os pubis, and below by the sharp edge of the internal obturator membrane. It is firm and unyielding, hardly admitting the index finger, and is the usual cause of strangulation in this region. This orifice is covered by the parietal peritoneum, which is usually only slightly movable, and beneath it compact subperitoneal tissue is found.

The studies of Bishop, Anson and Ashley have demonstrated that the so-called obturator canal is not truly canalicular but is merely a culdesac, the space that is left unoccupied by vessels and nerve is small, and the outer wall of the fossa is heavily muscular.

The structures which normally pass through the obturator canal in order of superposition are the obturator nerve, artery and vein. External to the pelvis and beneath the obturator externus muscle, the nerve, artery and vein each divide into an internal and external branch. Any of these openings can serve as a hernial passage. The obturator region is covered in part by the obturator externus and pectineus muscles. (Figs 210 and 211.)

**Hernial Openings**—The best classification of obturator hernias is that of Piqué and Poirier, which divides them into three varieties according to their location.

*1 In the Obturator Canal*—This variety enters at the internal opening or internal orifice and passes out through the external orifice, accompanied by the internal branches of the obturator nerve, artery and vein. It is in front of the external obturator muscle and is covered by the pectineus muscle. (This is the most frequent type of obturator hernia.)

*2 Between the Middle and the Superior Fasciculi of the External Obturator Muscle*—This hernia enters at the internal orifice and follows downward the route of the inferior branches of the obturator nerve, artery and vein. The hernia passes between, and is held by the upper and middle fasciculi of the obturator externus muscle.

*3 Between the External and the Internal Obturator Membrane*—The hernia enters the internal opening of the canal and passes downward between the internal and external obturator membranes. It is behind and covered by the external obturator muscle. In operating for this type of hernia, after the pectineus is separated, it is necessary to go through the obturator externus muscle to reach the hernia.

**The Sac**—The sac is formed by peritoneum and is forced downward into the canal by intraabdominal pressure. Small lipomas sometimes favor the descent of the sac.

*1 Size of the Sac*—Because of the narrowness of the obturator canal and the resistance offered by the obturator externus and pectineus muscles, the hernia is usually small and seldom palpable. Large hernias are very rare.

Fig 210

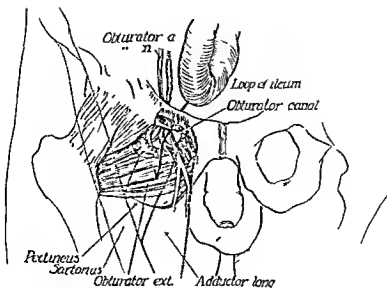
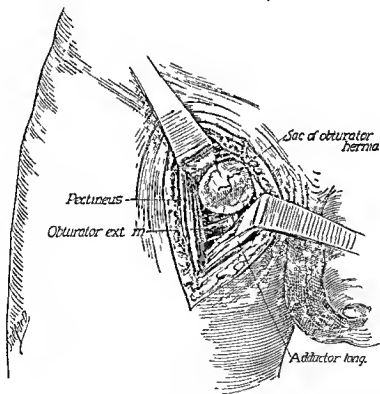


Fig 211



#### The anatomy of obturator hernia.

Fig 210.—The structures passing through the obturator canal in the order of their superposition behind the hernial sac are the obturator nerve artery and vein.

Fig 211.—Hernia in the obturator canal. This is the most frequent type of obturator hernia. The sac lies on the obturator externus muscle and is covered by the pectineus. The obturator nerve is seen directly behind the sac.

*2 Contents of the Sac*—Small intestine is usually the sole content of the sac, omentum is seldom present. Partial strangulation or Richter's hernia is common.

There are a few cases on record in which the ovary and the fallopian tube have been found. The nongravid uterus has been observed as in Kronlein's case in a woman, aged seventy years, who was operated on for strangulated right obturator hernia. The sac contained a coil of small intestine, the right ovary and tube, and the greater part of the uterus.

A portion of the bladder has been found a few times, the appendix is a rare content.

*Relation of the Hernia to Nerve and Vessels*—The nerve and vessels run between the peritoneum and the transversalis fascia.

*1 Artery*—The position of the artery is variable. It is usually behind the neck of the sac and to its outer side. English found that the position of the obturator artery was mentioned in 26 cases, it lay to the outer side of the sac in 13 cases, behind it in 9 and to the inner side in 6. These are probably hernias of the first variety, with the sac situated anteriorly and internal to the artery, if the latter comes from the internal iliac, which is its usual origin. In this variety the sac rests upon the vessels, while in the second and third varieties the vessels usually rest on the sac.

On account of the anastomosis between the epigastric and the obturator arteries, there is often an arterial loop around the neck of the sac. These vessels are small and of little importance, when the obturator comes from the internal iliac and the epigastric from the external iliac. When a branch of the deep epigastric artery replaces the obturator artery the vessels are in a dangerous position.

In about 10 per cent of all cases an abnormal obturator artery passes inward in front of the femoral ring, then arches downward to the inner side of the ring and lies on the lacunar ligament. The operator should be on the look out for the artery in this dangerous position when operating for strangulated femoral hernia, so as to avoid dividing it accidentally. It is not very unusual to find a complete arterial circle around the neck of the sac, as in the case described by Borch.

*2 Nerve*—The obturator nerve is usually on the outer side of the sac and above the artery which it accompanies. Sometimes the nerve is separated from the artery by fascia, when this happens, it is usually due to pressure of the hernial sac. According to Jaboulay and Patel, when the obturator nerve leaves the canal it expands into a trellis like network which delays the progress of the hernia, and often the nerve fibers can be seen holding back the hernial sac. Fredet saw a case in which a branch of the obturator nerve made a furrow on the external surface of the sac, and he advanced the ingenious hypothesis that as a hernia increased in size, the nerve was displaced to one side, and as the pressure was removed from the nerve, the referred pain along the course of the nerve disappeared. While the nerve is usually on the outer side of the sac, it may be in front, or rarely behind, or to the inner side of it. Macready states that in 21 cases the nerve was behind the sac 3 times and on the inner side twice.

The downward course of a hernial sac may be arrested by a branch of the obturator nerve, usually the anterior one. Traction on this nerve may cause pain, and even symptoms of paralysis, referred down the inner side of the thigh to the knee. These symptoms disappear as the sac emerges from the foramea, and leaves the nerve behind it. In some instances, the nerve offers such resistance that the hernial sac is diverted from its direct course, and lodges behind the obturator externus muscle. The nerve sometimes circles partly around the neck of the sac. In the pelvis, it is outside and above the neck, while external to the obturator foramen it lies below the sac.

### Etiology

**Predisposing Causes.**—*Sex*—Obturator hernia occurs six times more frequently in women than in men. Pregnancy is an important factor, because it sometimes leaves the parietal peritoneum relaxed. Another cause in women is the larger pelvis which inclines more obliquely than that in men, and the relatively larger size of the obturator foramen. The transverse diameter of the obturator foramen is nearly always greater in women than in men, in men the average is  $1\frac{3}{4}$  inches (3.5 cm.), while in women it is  $1\frac{1}{2}$  inches (4 cm.) in 50 per cent of the cases, and it is more oval in shape in women than in men.

*Relative frequency in men and women*

Bergar	118 cases	18 men	15.25
Lilloffe	90 cases	7 men	7.77
Pimbet	73 cases	8 men	10.95
Thiele	26 cases	2 men	7.69
Meyer	56 cases	4 men	7.14
Watson	323 cases	52 men	15.85

*Age*—As a rule, obturator hernia occurs earlier in men than in women; though it is very rare in either sex under fifty years of age. The youngest patient recorded was twelve years old. Of the 442 cases I collected, the ages were given in 299, and it was most frequent between sixty and seventy years of age.

*Emaciation*—Tissot, in 1872, was among the first of the earlier writers to remark upon emaciation as a cause of obturator hernia. Loss of weight causes a shrinkage of the fatty tissue in the obturator canal, thus favoring the entrance of a hernia. Fifty-five per cent of the cases of obturator hernia on record have occurred in women between sixty-one and eighty years of age who were very thin, often from recent loss of weight.

*Congenital Predisposition*—Congenital predisposition is a factor in obturator hernia. The obturator foramen has been examined frequently in the dissecting room, and also in the course of laparotomies. Sometimes there is an opening with a pouching of the peritoneum through the obturator canal, that in some instances is large enough to admit the tip of the finger, but there is no evidence of hernia.

*Other Causes*—Other predisposing causes are chronic bronchitis, emphysema, and laborious occupations. Vinson believes that pelvic peritonitis may favor the later development of an obturator hernia. Pimbet mentions pre-

vious attacks of ascites which may have left the obturator canal patulous thus favoring the formation of a hernia

**Accidental Causes**—Often the cause of obturator hernia is unknown. Sometimes it is due to direct injury for instance lifting a weight a fall from a height or a crushing blow or it may be due to indirect causes such as straining at stool coughing or sudden exertion. Rarely its onset is coincident with the appearance of an inguinal or a femoral hernia.

### Symptoms and Diagnosis

**Reducible Obturator Hernia**—When there is no tumor small reducible obturator hernias are seldom diagnosed unless they are accompanied by gastrointestinal symptoms or pain along the course of the obturator nerve. The point of exit is deeply placed and the hernia usually descends between the obturator externus and the pectineus muscles and lies beneath the adductor longus and pectineus. The hernia must be large to be palpable and should always be felt for on the inner side of the thigh. There may be a slight poorly defined tender swelling located below and internal to the femoral opening which suggests vaguely the signs of a reducible hernia. Sometimes the patient can feel the hernia slip out and is easily able to reduce it himself as in the case reported by McMahon. Large reducible obturator hernia is very rare. There are only a few cases reported in the literature such as those observed by de Garengeot, Berard and Mason.

Gastrointestinal symptoms that may be present are constipation occasional attacks of nausea vomiting and colic.

In the case of double obturator hernia reported by Van Zwalenburg the openings were approximately the same size, although during the attacks of colic the pain was more severe on the right side. At operation it was found that a mass of fat had partially occluded the left canal so that less intestine could enter it and this probably accounted for the milder degree of pain on the left side.

Pressure on the obturator nerve may be manifested by numbness or cramps in the thigh or leg which are relieved by changing position. This symptom is more often present and is more severe in strangulated hernia but when it is found in reducible hernia it is the most important symptom and in some instances it alone has led to a correct diagnosis.

**Strangulated Obturator Hernia**—Strangulation in obturator hernia is very frequent because of the unyielding nature of the internal opening of the obturator canal—the bony wall above and the sharp edge of the firm inelastic internal obturator membrane below. The point of constriction is almost always at the neck of the sac where it is pinched by the internal obturator membrane. Strangulation is occasionally caused by the external obturator membrane or by intrapelvic constrictions.

The symptoms may be intermittent suggesting a partial enterocele or continuous pointing to a complete strangulation. When strangulation is com-



plete gangrene and perforation appear early. Partial enterocoele frequently occurs but unless the symptoms are sufficiently severe to necessitate operation it is seldom diagnosed.

**Examination**—The examination should be made in a well lighted room. Sometimes a slight bulge or fullness can be seen in the obturator region when no tumor can be felt. With the patient in the dorsal position the pectineus adductor longus and obturator externus muscles are relaxed by flexing, adducting and rotating the thigh outward. With the patient in this position

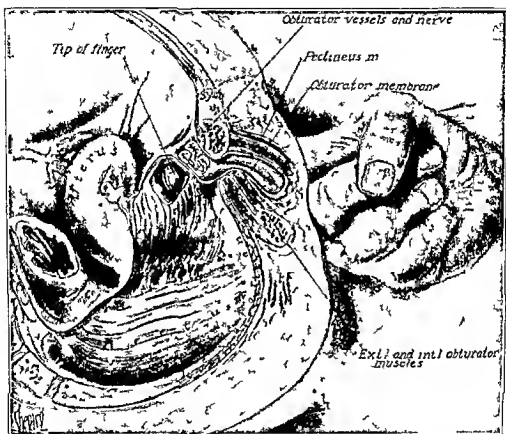


Fig. 212.—The anatomy and diagnosis of obturator hernia. Showing the relations of the sac to the obturator and pectineus muscles. The hernia can sometimes be felt as a tender mass at the obturator foramen by digital examination through the rectum or the vagina.

a tumor or sensitive spot can almost always be felt if a hernia is present. It is painful, tense and irreducible. The hernia may sometimes be diagnosed by means of a rectal or vaginal examination (Fig. 212). In strangulation there is pain over the obturator region which is increased when the obturator externus muscle is put on the stretch by abducting and rotating the thigh inward.

**Pressure on the Obturator Nerve**—I am along the course of the obturator nerve is the most important symptom of obturator hernia and is present in more than 50 per cent of all cases. Attention was first called to it by Howship

in 1840, and again by Romberg in 1845 and it is known as the Howship Romberg sign. However, de Garengot stated that in the case he observed in 1733, traction on the tumor *per taginam* caused pain in the knee. The pain may be a dull ache extending down the inner side of the thigh to the knee, occasionally as far as the middle third of the leg, and rarely to the great toe. This symptom is most often noticed in strangulated hernia, and the pain is more severe than when the hernia is reducible. In a few instances pain has radiated to the hip joint. The limb is usually kept in a semiflexed position and movement is painful. In others, it may take the form of a neuritis, varying in intensity from a mild prickling, tingling burning sensation to the severest of cutting and shooting pains. It is usually intermittent, and change of position affords temporary relief. In a few cases it has been continuous in character and so severe as to result in partial paralysis of the extremities. This sign is absent when the nerve lies to the inner side of the sac where it is free from pressure. When the nerve is dislocated or pushed out of the way by the advance of the sac, and the pressure removed the sign of referred pain will be absent. Franklin's patient experienced a continuous pain over the obturator nerve for a period of four days.

In the case reported by Milligan the patient complained of pain in the right thigh over the inner portion of Scarpa's triangle with indefinite tenderness over the inner and upper portion of the pectineus muscle. These symptoms were aggravated many times during the day and once or twice at night by any sudden turning of the leg outward while the patient was asleep. Van Zwalenburg's patient could assume the knee chest position for a few minutes thereby relieving the colicky symptoms the referred pain along the course of the obturator nerve, and the tenderness in the obturator region.

Marshall's patient complained of a burning pain increasing to a stinging ache, which was referred to the dorsum of the penis and down the inner side of the left knee, encircling the patella when at its worst. It was associated with localized tenderness over the obturator region and had been present for two years. It was usually relieved by walking, stooping and moving around, sitting down for fifteen to twenty minutes and by lying in bed.

Stones' patient noticed a prickling, burning sensation in the right iliac region, radiating down the inner side of the right thigh. This pain, which had occurred several times during the two previous years and had lasted one or two days, was the only sign of obturator hernia until the sudden onset of obstruction.

### Differential Diagnosis

In many instances obturator hernia is discovered during an operation for intestinal strangulation, in others the symptoms are believed to be due to a femoral, inguinal or umbilical hernia or intestinal obstruction which is operated on, while the strangulated obturator hernia is overlooked and not discovered until a second operation for the unrelieved symptoms or at autopsy. This happened in 18 of 442 cases of obturator hernia which I collected from the literature.

Obturator hernias are sometimes bilateral or combined with other hernias in this region, especially femoral. In both Olshnes' and Rischbieth's patients the obturator hernia was complicated by scrotic hernia. Both obturator canals should always be examined. Rarely there is a strangulated obturator hernia on one side, and a nonstrangulated one on the other, several cases of double obturator hernia are on record.

**Femoral Hernia**—Obturator hernia is more frequently mistaken for femoral hernia than for any other variety. The obturator hernia is below and internal to the femoral opening, and comes from beneath the pectineus. In femoral hernia the Howship Romberg sign is absent, and bimanual examination shows that the obturator canals are free. The patient reported by Mc Mahon gave a history of obturator hernia for four years, which he could reduce previous to the occurrence of strangulation. In spite of the typical symptoms, a positive diagnosis could not be made until laparotomy was performed.

**Perineal Hernia**—Perineal hernia makes its exit below the arch of the pubes, and as its course is different, there is little chance of confusing it with obturator hernia.

**Adenitis**—Adenitis may rarely occur in the obturator region, but the presence of other enlarged glands will serve to exclude obturator hernia.

**Psoas Abscess**—Psoas abscess appears above the pectineus, and is soft, fluctuating and painless, and the history serves to distinguish it from obturator hernia. Pimbet mistook an abscess situated beneath the pectineus muscle for a strangulated obturator hernia.

**Varicose Veins**—A saphenous varix or arteriovenous aneurysm may occur in the obturator region, and the diagnostic signs are the same as when the condition is found elsewhere.

**Pain Along the Course of the Obturator Nerve**—The Howship Romberg sign is the most important symptom in the diagnosis of obturator hernia, but there are several other conditions in which it may occur. *Rheumatism* is infrequently confined to the inner side of the thigh, and there is often a history of involvement of other regions. The Howship Romberg sign is sometimes mistaken for rheumatism in the elderly, and especially in those subject to it.

**Neuralgia**—Simple neuralgia of the obturator nerve is rare, occasionally the anterior crural nerve is affected, and the pain and tenderness involve the front of the thigh as far as the knee or follow the saphenous branch down the inner side of the leg as far as the great toe. Sometimes this is associated with sciatica—or neuralgia in other parts of the body.

**Other Conditions**—In spondylae or hip joint disease, the first symptom may be pain on the inner side of the knee. Malgoney of the cecum and sigmoid pelvic peritonitis and perimetritis, by pressure on the obturator nerve in the pelvis, may cause a referred pain down the inner side of the thigh.

**Internal Hernia**—The history of recurrent attacks, which Meyer compares to the stages of "attack" and "interval" in chronic appendicitis, will help to distinguish a strangulated internal hernia from an obturator hernia.

**Possibility of Making a Diagnosis**—In the series I studied, 269 patients were treated by operation or died from strangulation. Of these a diagnosis was made in only 58 (21.5 per cent.)

### Prognosis

The course of nonstrangulated obturator hernia is one of intermittent attacks of partial obstruction, which tends to become progressively worse, eventually ending in complete strangulation. The mortality of strangulated obturator hernia is high, therefore the prognosis is always grave. Gangrene of the intestine occurs early and has been found in 25 per cent of the cases that have come to operation. As our knowledge of obturator hernia increases and we are able to make the diagnosis early, sometimes before strangulation occurs, the mortality rate is decreasing. In Graser's collection of 118 cases, reported before 1890, the mortality rate was 78.81 per cent, Macready in 1892 placed it at 84.25 per cent, and Rose in 1893 gave it at 78.75 per cent. In my series of 269 patients who were treated with or without operation there were 160 deaths (60 per cent). Sixty-four of these were reported between 1910 and 1923. Three patients died without operation. 61 were treated by operation and of these 38 survived and 23 died (37.7 per cent). Recurrence is to be expected in about 10 per cent of the cases operated on by laparotomy. By the obturator route, this figure is a little higher both for recurrence and for mortality.

An operation for the relief of strangulated hernia should always be followed by a radical operation to close the obturator opening. Several instances are on record in which the strangulation has recurred when the radical operation has been neglected. To lessen the tendency to recurrence the patient should be made to gain in weight.

### Treatment

**Simple Obturator Hernia**—In early times reducible obturator hernia was never correctly diagnosed, usually being mistaken for femoral hernia. The treatment consisted of a bandage and in 1804 Cooper advocated the femoral type of spring truss, with an extra thick pad to make firm pressure on the thigh.

With our increased knowledge of the pathology of obturator hernia, we know that truss treatment is not safe, even if the truss fits and holds the hernia in position, because there is the ever present danger of strangulation. Mc Mahon's patient had worn a truss that was fairly comfortable and had held back the hernia for four years before strangulation suddenly occurred. In many instances the truss is uncomfortable and cumbersome, and the patient refuses to wear it. The radical operation should always be advised.

**Strangulated Hernia—Taxis**—It is always dangerous to attempt taxis, because gangrene sets in early and the danger of rupturing the intestine is great. Immediate operation without preliminary taxis is to be recommended. One of the earliest cases of strangulated obturator hernia that was treated by taxis was described by de Garengeot in 1743. After raising the pelvis and the knees, the tumor was rubbed from below upward, and the intestine slowly returned as the tumor, which was 5 to 6 inches (12.5 to 15 cm.) in length, gradually disappeared. The patient felt a gurgling sensation in the abdomen, and the pain and vomiting which had been present for three days suddenly ceased.

The best method of taxis is as follows. The patient's thigh on the affected side is slightly flexed and everted so that the outer side of the knee rests lightly

on the bed and the pelvis is raised. While an assistant compresses the hernia the physician with one hand on the pubes attempts to force back the intestine, and with a finger of the other hand in the vagina or the rectum endeavors to disengage the loop of strangulated intestine.

**Operative Treatment**—There are two routes for operating on obturator hernia: the abdominal and the obturator and in certain instances it is necessary to use both.

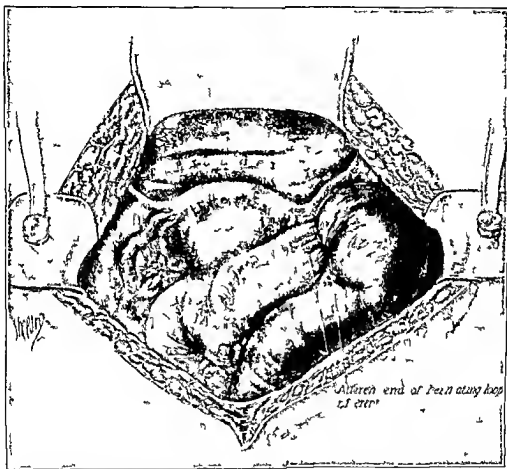


Fig. 213.—Abdominal operation for strangulated obturator hernia. The point of constriction is located by following the proximal or distal loops of intestine down to the obturator foramen. Traction on the loop must be very gentle as there is always danger of tearing the bowel if it is gangrenous.

**Abdominal Route**—Laparotomy is the operation of choice because it permits resecting the intestine in case there is gangrene without the necessity of making a second incision which would be required if the obturator route were used. There are other advantages of the abdominal approach. It enables the operator to confirm the diagnosis promptly; it permits an easier reduction of a nonstrangulated hernia; it allows a safer handling of gangrenous intestine; there is less danger of accidental hemorrhage from the obturator artery and the op-

eration can be carried out more rapidly than by the obturator route. Wakeley also emphasizes the advantages of the abdominal route.

**Operation**—The patient is placed in the Trendelenburg position. If there is any question regarding diagnosis a median incision below the umbilicus is used. If the hernia has been definitely diagnosed a lateral rectus incision is made on the same side as the hernia. All the possible sites of hernia are examined. The strangulated obturator hernia is located by following down the afferent and efferent loops of intestine and the constricting ring gently stretched with the finger, a grooved director or by inserting a hemostat and carefully spreading the blades (Fig. 213). If the uterus can be plainly seen on the outer side of the opening the constriction can be slightly nicked downward and inward. Traction on the strangulated loop must be very gentle as there is always danger of tearing gangrenous bowel. Eccles reported a case in which this accident occurred. While making gentle traction on the strangulated loop it suddenly gave way leaving a gangrenous opening in the intestine the size of a three penny piece.



Fig. 14

Fig. 15

Abdominal operation for obturator hernia.

Fig. 14—The sac is inverted and a ligature passed around its base. If the sac is large a part of it is resected.

Fig. 15—The remaining portion of the sac is folded on itself to form a plug which is fastened by interrupted sutures over the obturator foramen.

The strangulated loop is usually very small and reduction is aided by having an assistant press over the pectineus muscle from the outside while the operator makes traction cautiously to release the strangulation. If gangrene is probable it is advisable to have the field walled off by compresses and intestinal anastomotic clamps placed on afferent and efferent loops of intestine. The strangulated loop of intestine if viable is returned to the abdomen; if the gangrenous area is small it should be invaginated and closed over with interrupted Lembert sutures. If intestinal resection is necessary an end-to-end anastomosis can be done or if the patient's condition is serious the Murphy

button can be used. The portion of intestine that has been inverted or resected is covered over by a flap of omentum which is fastened in place by a few sutures, thus lessens the dangers of leakage and adhesions.

**The Sac**—The simplest treatment of the sac is to invert it, by seizing its lower end with a forceps and making traction. A ligature is placed around the base, and the whole or a part of the sac is resected, or several sutures can be passed through the sac and tied, and the plug thus formed is stitched over the obturator foramen. (Figs 214 and 215.)

In case the sac cannot be inverted, as much of it as possible should be freed from the canal, and the edges sutured together to close the opening. Corner and Huggins reported a case in a woman who had three operations for recurrent strangulated obturator hernia. At the first two operations no attempt was made to close the opening on account of the poor condition of the patient, at the third operation the internal opening of the obturator canal was closed and there was no further trouble. Short closed the canal with a piece of rib.

**Obturator Route**—The obturator route is used less frequently than the abdominal, although it is still preferred by some operators. The pelvis of the patient is elevated on a sandbag and the thigh flexed and abducted. The femoral artery is located, and at a point midway between the artery and the spine of the pubis an incision 3 or 4 inches (7.5 or 10 cm.) long is made, with its center over the tumor. According to Trelat, the incision should be 35 mm. internal to the femoral artery, which is about the same as Lejars' directions of  $1\frac{1}{2}$  inches (3.7 cm.) internal to the femoral artery. The subcutaneous tissue and fascia lata are divided. If the saphenous vein is in the way, it is divided between ligatures, at the upper edge of the adductor longus, the external pudic artery is sometimes encountered, and it can also be divided. The upper border of the adductor longus is retracted downward and inward. The pectineus muscle is located, and the space between it and the adductor longus is opened, if this does not give a good exposure, the pectineus muscle can be cut transversely. The nerve will be found coming through above the obturator muscle or through its upper fibers.

The hernial sac must be opened and the contents inspected before the constriction is divided or the hernia reduced. If there is gangrene, laparotomy should be performed and the intestine treated from above. If the contents are viable, the constriction can be stretched by pulling downward and inward with the finger or by introducing a closed hemostat and carefully separating the blades. (Fig 216.) If this is not sufficient to permit reduction of the hernia it is necessary to incise the internal obturator membrane which is causing the strangulation. The artery should be located and the membrane cautiously nicked at a point where there is no danger of hemorrhage. The artery is usually behind and below but sometimes it is in front, and rarely an arterial circle may surround the obturator opening. The constriction must never be divided until the artery is felt or seen, serious hemorrhage may occur if the artery is accidentally wounded. With the hernia reduced, the sac may be dissected out, ligated and excised. Straker suggested closing the obturator

canal with a flap  $\frac{1}{2}$  inch (1.3 cm) wide and about 3 inches (7.5 cm) long taken from the inner side of the pectineus muscle. It is drawn through the canal by an aneurysm needle or a heavy suture and the wound closed. This method has been successfully used by Kindl.

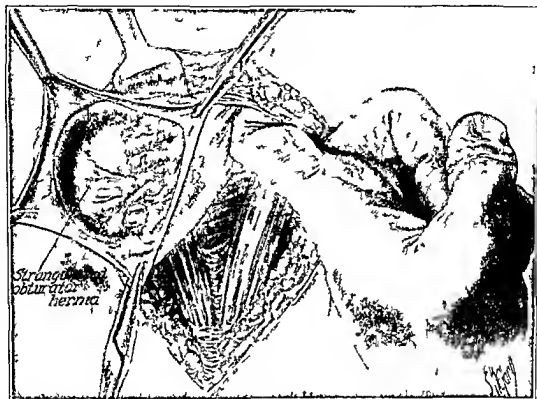


Fig. 216—Operation by the obturator route. After the skin and subcutaneous tissues are divided the hernia is exposed by retracting the pectineus muscle outward and the adductor longus inward. The constriction can often be stretched sufficiently by pulling downward and inward with the index finger to permit the reduction of viable intestine.

**Combined Operation**—Occasionally when the obturator operation is undertaken it is also necessary to open the abdomen from above to treat strangulated intestine or to control hemorrhage or to close the internal opening. Corner and Huggins have reported a case in which the internal opening could not be closed through the obturator incision and it was necessary to perform a laparotomy and invert the sac by pushing it up from the outside. Jaboulay and Patel reported two instances in which the obturator operation was done and in both the intestine was so tightly constricted that it was necessary to open the abdomen from above to relieve the strangulation. Albertin encountered a Richter's hernia which could not be reduced through the obturator incision so he prolonged the thigh incision upward and opened the abdomen above the inguinal ligament.

**Radical Cure**—In the last few years owing to improved methods in diagnosis nonstrangulated obturator hernia is being more frequently recognized and treated by radical operation.



**Inguinal Route for Obturator Hernia**—The inguinal route for obturator hernia has recently been used with success by Milligan and by Kindescherf. Milligan made an oblique incision parallel to the inguinal ligament and just above the inner end of it, exposing the external abdominal ring and the attachment of the external oblique aponeurosis to the inguinal ligament. The aponeurosis was incised in the line of the skin incision, and the upper part retracted. The spermatic cord was drawn upward out of the way, the external iliac vein located and the femoral ring defined. The peritoneum was retracted upward from the pubic bone, and the obturator foramen could be seen and felt about one inch (2.5 cm) behind the femoral ring, the obturator nerve could be plainly seen. The hernia was nonstrangulated and had reduced itself spontaneously, the sac was easily inverted and obliterated by suturing. Kindescherf concluded that this method of approach is especially adapted to a nonstrangulated hernia, but he does not recommend it for the strangulated variety because it does not provide enough room to deal expeditiously with a gangrenous intestine.

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## CHAPTER XXVIII

### SCIATIC HERNIA

**Synonyms**—Sacrosciatic hernia ischiatic hernia gluteal hernia hernia incisaure ischiadicæ ischiocele

**Definition**—A sciatic hernia is one that makes its exit through the greater or lesser sacrosciatic foramen. It is the rarest of all hernias. I was able to find only 35 cases in the literature.

#### Historical

Sciatic hernia was probably first observed by Veidier in 1753. In 1757 Haller described a sciatic hernia containing a portion of the bladder and in 1759 in the course of a dissection of a female Camper found a sciatic hernia which contained an ovary. Schreger in 1819 observed two cases of congenital sciatic hernia. In one case the tumor was rounded and elastic following strangulation it had ulcerated and a fecal fistula had formed. In the second case there was a round tumor with a pedicle the hernia was irreducible and was operated on by mistake for a cyst and the patient died. Meinel in 1849 saw a mass the size of a fist on the right buttock of a newborn infant. He opened the tumor which was cystic and it also contained a loop of intestine the child died. Knuppel in the same year saw a sciatic hernia in a man aged thirty three years it was soft and reducible and descended to the middle of the thigh. Cheneux in 1890 reported a sciatic hernia of the ovary and about the same time Schullbach observed the case of a woman who died from strangulation of sciatic hernia at autopsy, intestine and ovary were found in the sac. Crossle in 1873 saw a sciatic hernia which was caused by a strain.

Fowler in 1902 reported the first case of sciatic hernia of a Meckel's diverticulum. Marchetti in 1919 observed a sigmoid diverticulum. Perry in 1920 recorded a strangulated sciatic hernia complicating pregnancy.

Brodnax in 1924 found a Meckel's diverticulum in a sciatic hernia. Villechaise and Jean in 1925 reported the case of a woman with sciatic hernia who had had previous attacks of sciatic neuralgia. Fervers in 1930 observed a man with sciatic hernia and reviewed the literature. Wakeley in 1938 saw a woman with a mass in the gluteal region which he diagnosed as a sciatic hernia before operation. Bonnev in 1946 reported a sciatic hernia that had been observed in the dissecting room.

#### Statistics

In 1946 I collected 35 cases of sciatic hernia from the literature.

**Age**—In 32 of the 35 cases I collected from the literature the ages of the patients were as follows

Under 1 year	4
1 to 10 years	1
11 to 20 years	0
21 to 30 years	6
31 to 40 years	7
41 to 50 years	6
51 to 60 years	4
61 to 70 years	0
71 to 80 years	1
Child	1
Adult	1

**Sex and Site**—In 31 cases the sex of the patient and the site of the hernia were given as follows

MALE		FEMALE			RIGHT SIDE, SEX NOT GIVEN
R	L	R	L	SIDE NOT GIVEN	
6	8	8	5	3	1

### Anatomy

**Course of Sciatic Hernia**—A sciatic hernia may escape through the greater sacrosciatic foramen or through the lesser sacrosciatic foramen. It makes its exit most frequently through the greater sacrosciatic foramen, above the pyriformis muscle. Before the hernia enters the sacrosciatic foramen, its position is in the pelvis, in front of the pyriformis muscle and sciatic nerve. After passing through the sacrosciatic foramen, it crosses over the nerve and lies behind it, and is covered by the gluteus maximus muscle and fascia. As the hernia enlarges, it passes into the thigh at the lower border of the gluteus maximus muscle, or it may pass forward toward the groin, above the trochanter.

The course of sciatic hernia is toward the buttock and thigh, and it is confined to the side in which it makes its appearance. It cannot extend upward, because of the attachment of the gluteus maximus muscle to the ilium and the lumbar fascia, and it cannot extend forward, on account of the gluteus medius and gluteus minimus. The hernia is prevented from extending backward and inward by the absence of subcutaneous tissue, and the mass of muscle fibers, which have their insertion in the region of the coccyx and anus. The natural course of sciatic hernia, therefore, is downward, with the sciatic nerve. This is the path of least resistance because there is an abundance of loose areolar tissue in the thigh which offers only slight restraint. The hernia sometimes forms a hard mass beneath the muscles in the middle of the thigh, and in rare instances it may reach the leg. The tumor may be as small as a pigeon's egg or as large as a man's head (Fig 217).

The sacrosciatic ligaments divide the sciatic notch into two foramina, the greater and the lesser. The greater sacrosciatic foramen is bounded above and in front by the posterior border of the *os innominatum*, behind, by the great sacrosciatic ligament, and below, by the lesser sacrosciatic ligament. The lesser sacrosciatic foramen is bounded in front, by the tuberosity of the ischium, above, by the spine and lesser sacrosciatic ligament, and behind, by the greater

**sacrosciatic ligament** The greater sacrosciatic foramen is divided into two parts by the piriformis muscle which passes through it. Above this muscle, the gluteal vessels and the superior gluteal nerve leave the pelvis, below it, the sciatic artery, vein and nerve, the internal pudic vessels and nerve, the inferior gluteal nerve and the nerves to the obturator internus and quadratus femoris muscles.



Fig. 217.—Course of sciatic hernia. The hernia usually passes downward into the loose areolar tissue of the thigh. It may attain the size of a man's head.

**Varieties of Sciatic Hernia**—Sciatic hernia is most conveniently divided into three varieties: the suprapyramidal which appears through the great sacrosciatic foramen above the piriformis muscle; the subpyramidal which also comes through the great sacrosciatic foramen but is below the piriformis muscle; and the subspinous which makes its exit through the lesser sacrosciatic foramen below the spine of the ischium. In strangulation the point of constriction is at the opening between the bone and the sacrosciatic ligaments.

**1 Suprapyramidal Hernia**—The suprapyramidal hernia lies to the outer side of the gluteal artery and is bounded above, by the posterior border of the os innominatum, and below and externally, by the pyriformis muscle.

**2 Subpyramidal Hernia**—The subpyramidal hernia lies on the inner side of the sciatic nerve and artery, and the internal pudic vessels. It is bounded above, by the pyriformis muscle, and below, by the superior border of the greater sacrosciatic ligament.

**3 Subspinous Hernia**—The subspinous hernia is bounded above, by the spine and lesser sacrosciatic ligament; behind, by the greater sacrosciatic ligament, below and externally, by the bony arch which is covered by the tendon of the obturator internus muscle. The internal pudic vessels and nerve lie to the outer side of the hernial sac.

**Frequency of the Varieties**—Of the 35 cases I collected from the literature 16 were suprapyramidal, 7 subpyramidal, and 1 subspinous. (In the remaining cases, the variety was not mentioned.)

**Contents of the Sac**—The most frequent content of the sac is small intestine, sometimes omentum or large intestine, ovary, tube, and bladder are found. In the cases I collected the contents of the sac were given in 22 as follows:

Small intestine	11
Small intestine and bladder	1
Bladder	1
Ovary	2
Ovary and tube	2
Sigmoid	2
Colon	2
Meckel's diverticulum	1

### Etiology

**Predisposing Causes**—In 1811 Monro suggested that sciatic hernia might be due to a congenital defect. Of the 35 cases I collected six patients were born with sciatic hernia. Other predisposing causes are traction due to tumors in the gluteal region, relaxation of muscles, constipation, strain and laborious occupations.

**Sex**—Sciatic hernia occurs with nearly equal frequency in the two sexes. In women it has usually been found in those who have had one or more pregnancies.

**Age**—The oldest patient on record was seventy-two years. Most of the men were between thirty and forty, while a majority of the women were past forty years.

**Accidental Causes**—The most frequent accidental causes of sciatic hernia are direct and indirect injury. Any operation in the gluteal or sacral regions may be followed by postoperative hernia.

### Symptoms and Diagnosis

**1 Reducible Sciatic Hernia**—The symptoms of small sciatic hernia are always obscure unless there is a tumor. There may be only a slight swelling in the gluteal region with a tender point over the sacrosciatic foramina. Some

times there is pain radiating down the sciatic nerve. In Wassilieff's case, the pain radiated to the upper part of the thigh. In Perry's case, the pain was referred down into the right leg. Martel reported a case of sciatic hernia that caused the patient to lose the use of the lower limb, the condition persisted for five months, being relieved only when the hernia was operated on and the pressure removed from the sciatic nerve.

If the hernia is large there will be a soft round tumor which is more or less reducible, and gives an impulse when the patient coughs or strains in any way. If the sac contains intestine, a gurgling sound can be heard as the hernia is reduced. Subjective symptoms are indefinite. Occasionally these patients complain of colicky pain, and some have been more comfortable when lying down. In a majority of cases the diagnosis is not made until strangulation occurs. Roentgen ray examination should not be neglected. In Marchetti's case the shadow of the hernia was clear and enabled the author to confirm his tentative diagnosis (Fig 218).

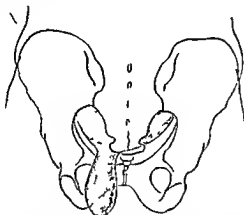


Fig 218—Diagram of roentgen ray picture of sciatic hernia of a diverticulum of the sigmoid (courtesy of Dr. Marchetti)

**2 Strangulated Sciatic Hernia**—The diagnosis of strangulated sciatic hernia is usually made during the course of a laparotomy for intestinal obstruction. If, in addition to the symptoms of intestinal strangulation, there is a tense irreducible tumor in the gluteal region, strangulated sciatic hernia should be suspected. In searching for a tender point where there is no tumor, the sacrosciatic notch can be located by placing the patient in a recumbent posture and drawing a line from the posterior superior spine of the ilium to the upper surface of the greater trochanter. The sacrosciatic notch, which is crossed by this line, is just below the junction of the middle and upper third of the line.

In most of the cases reported, only a small loop of intestine has been strangulated. Rarely a part of the intestinal wall has been caught in the constriction (partial enterocoele), as in the case reported by Perry, in which the symptoms constipation, colicky pain, nausea vomiting, and some distention of the abdomen, pointed to complete strangulation.

### Differential Diagnosis

Sciatic hernia sometimes occurs with hernia in other regions. Olivares saw a patient with sciatic and obturator hernia and Rischbieth saw one who had sciatic obturator and femoral hernia.

**Myxomas and Lipomas**—These tumors are of slow growth and are not reducible. They do not give an impulse on coughing unless complicated by hernia. Bass recorded a case of retroperitoneal lipoma that simulated a sciatic hernia.

**Abscess**—Abscess especially when it follows hip joint disease may form a tumor on the posterior surface of the thigh but the history of the course of the disease and the absence of the characteristic signs of sciatic hernia make diagnosis possible.

**Perineal Hernia**—Perineal hernia is distinguished from sciatic hernia by its location above the greater sacrosacral ligament.

**Other Diseases**—Sciatic hernia may sometimes be mistaken for the following conditions: fibroma, echinococcus, cyst, malignant growth, aneurysm, spina bifida, and gluteal abscess.

### Prognosis

Because of the difficulty in diagnosing sciatic hernia the prognosis is grave. A majority of the cases on record were not diagnosed until after strangulation had occurred. On account of the danger of strangulation operation should always be undertaken as soon as the diagnosis is made.

Of the 35 cases I collected from the literature 13 were treated by operation. 11 patients recovered and 3 died. Nine patients had reducible hernias and were treated with a bandage. Eight cases were found at autopsy; death was due in 6 of these to strangulation.

### Treatment

Radical operation preferably through an abdominal incision is the treatment of choice for sciatic hernia. The advantages of laparotomy over the sciatic operation are: less danger of hemorrhage; the operation can be carried out more rapidly; the sac can be ligated higher; the opening can be closed more securely; and if strangulation is present it can be taken care of without the necessity of making a second incision as is required when the sciatic operation is employed.

**Mechanical Treatment**—The truss or bandage treatment of sciatic hernia is unsatisfactory because of the difficulty of fitting a support to this region and the constant danger of strangulation.

**Strangulated Hernia**—Taxis is not to be recommended although it may rarely succeed as in the case reported by Wassilieff.

There are two routes for operating on sciatic hernia: the abdominal and the sciatic.

**Abdominal Operation**—The patient is placed in the Trendelenburg position and the abdomen opened by a median incision below the umbilicus. In



the female the sciatic opening is found behind the broad ligament (Fig 219) The loops of distended and collapsed intestine are followed down to the sciatic opening and very gentle traction is made to reduce the strangulation while an assistant makes firm counter pressure over the gluteal region. If this does not succeed the opening should be stretched downward and outward by means of a finger & grooved director or by inserting a closed clamp and carefully separating the blades. If the constriction cannot be stretched sufficiently to permit reduction of the hernia free exposure of the ring should be secured the artery and nerve located and the constriction cautiously incised downward and outward. If the intestine is viable it is returned to the abdomen; if only a small area is gangrenous it may be inverted by Lambert sutures. If a resection is necessary a lateral or an end to end anastomosis can be done or a Murphy button employed and the raw surfaces covered over by a flap of omentum.

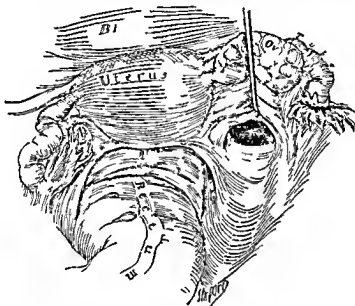


Fig 219.—Anatomy of sciatic hernia. In the female the sciatic opening is found behind the broad ligament.

If the sac is small it may be seized at the bottom with a clamp inverted and tied off. The sac may be folded upon itself sutured and used as a pad to close the opening or the opening can be closed over with fascia or a flap from the piriformis muscle (Figs 220 and 221). Perry reported a case of strangulated sciatic hernia in a woman eighteen weeks pregnant. The abdomen was opened by midline incision and a Richter's hernia was found in the sciatic opening. The intestine was torn in freeing it from the constriction and an end to end anastomosis was done. The sciatic opening was above the piriformis on the right side and admitted the tips of two fingers for a distance of  $\frac{1}{2}$  inch (1.25 cm). The pregnancy was undisturbed and went to term.

**Sciatic Operation.**—The incision which is 4 to 5 inches (10 to 12.5 cm) long, is made over the center of the tumor on a line drawn from the posterior

inferior spine of the ilium to the middle of the posterior border of the great trochanter. The gluteus maximus muscle is incised, and the edges are retracted to give a wide exposure, so that each layer of tissue may be clearly seen before dividing it, thus avoiding serious hemorrhage from the gluteal artery and injury to the sciatic nerve. The sac is beneath the gluteus maximus muscle, and if it is of the suprapiriform type, which is most frequent, the sciatic notch will be above the neck of the sac, and the piriformis muscle will

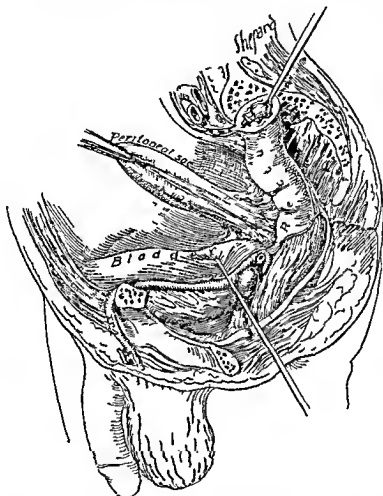


Fig. 920.—Abdominal operation for sciatic hernia. The constriction is relieved, the hernial contents are reduced and dealt with and the sac inverted. The sac may be folded on itself, sutured and used as a pad to close the opening.

be below it. The gluteal artery is usually above. The sac should always be opened and the contents inspected before any attempt to reduce the hernia is made. The constriction should be relieved by stretching it downward and outward, either by means of the finger, a grooved director, or by inserting a clamp and cautiously spreading its blades. If it is necessary to incise the constricting ring, several shallow notches can be made, followed by digital dilatation. The constriction should be divided below, in suprapiriform hernia, and at the inner side, in the subpiriform and subspinous varieties.

If the intestine is viable, it is returned to the abdominal cavity. If the gangrenous area is small, it can be turned in, and the edges of the normal intestine sutured over it and reenforced with a flap of omentum. If gangrene involves the whole loop, it should be dealt with through an abdominal incision.

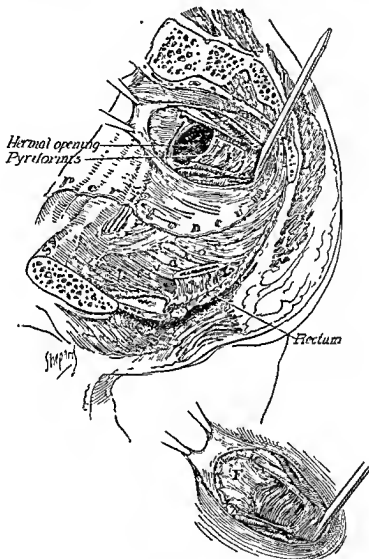
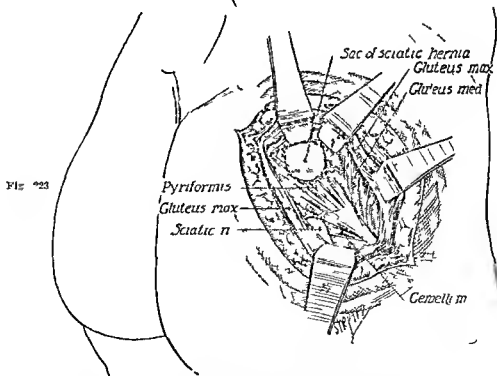
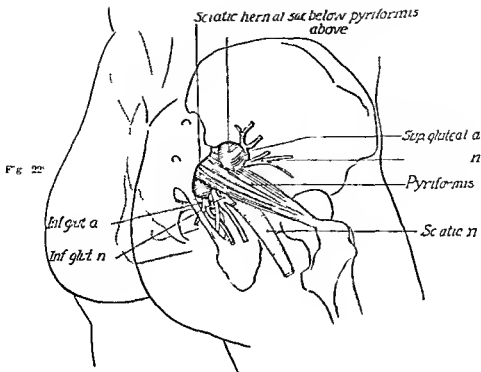


Fig 221—Abdominal operation for sciatic hernia. The sac has been excised and a flap of fascia turned up from the pyriformis muscle, and tacked over the opening by interrupted sutures.

The sac is ligated and excised or used along with a flap from the pyriformis muscle, to close the opening. (Figs 222 and 223) The objections to the sciatic operation are: the depth of the wound; the danger of hemorrhage from the gluteal artery; the possibility of injury to the sciatic nerve; the chance of encountering strangulated intestine; and the difficulty of closing the hernial opening.



The anatomy of sciatic hernia.

Fig 222—Suprapiriformal hernia. This variety of hernia passes the greater sciatic notch above the piriformis muscle and emerges through the same notch below the piriformis.

Fig 223—Operation by the sciatic route. The incision is made over the center of the tumor the gluteus maximus muscle incised and the edges are retracted to expose the sac. If the hernia is of the suprapiriformal type the sciatic notch will be above the neck of the sac and the piriformis muscle below.

**Combined Operation**—In certain instances, it may be advisable to use both the sciatic and the abdominal routes. The sciatic operation may be required to aid in the reduction of the hernia and to permit the complete removal of a large sac, while the abdominal operation is necessary when extensive gangrene or other complications are present.

**Radical Operation in Nonstrangulated Hernia**—Nonstrangulated sciatic hernia and openings in the sacrosciatic foramina discovered in the course of other abdominal operations should always be closed by muscle or fascia flaps, on account of the danger of a strangulated hernia occurring later.

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## CHAPTER XXIX

### PERINEAL HERNIA

**Synonyms**—Ischiorectal hernia (Lacoste), pudendal hernia (Cooper), posterior labial hernia (Seilei), subpubic hernia (Winckel), hernia of Douglas' pouch (Berger), hernia through the outlet of the pelvis (Macready), hernia through the pelvic floor (Boecard), levator hernia (Blake and Chase), vaginal hernia, labio vaginal hernia, coecygeal hernia

**Definition**—Perineal hernia is a protrusion of abdominal viscera through the muscles and fascia of the outlet of the pelvis

#### Historical

The first case of perineal hernia was observed by Méry in 1713—a perineal hernia of the bladder that was the size of an egg, and reducible. Soon after Méry's report, Curade saw a pregnant uterus, together with part of the bladder in a perineal hernia. Smellie, in 1731, described perineal hernia in women. Some writers believe that Méry's, Curade's and Smellie's cases were subpubic hernia, and not true perineal hernias.

Da Garengot, in 1736, reported a case of true perineal hernia. Papen's case of perineal hernia, observed in 1750, is undoubtedly a case of perineal hernia, but it has been erroneously included by some writers with the first cases of sciatic hernia. Papen wrote that there was an oval opening on the right side of the anus and coecum, which was bounded by the sacrosciatic ligament, the ischium, and the pubic bone. Chardenon, in 1740, observed the first case of perineal hernia in a man. He was forty five years old and the hernia was discovered at autopsy. Pipelet, in 1760, reported a second case in a man, and Bromfield, in 1773, found a perineal hernia in a boy.

Verdrier's monograph on hernia of the bladder was published in 1753, and also dealt with perineal hernia of this viscus. Richter, in 1785, advanced the theory that these hernias are due to an abnormal opening in the levator ani muscle between the rectum and the bladder. Sahatier agreed with this opinion, but Chopart and Desault, in 1797, did not accept it. Scarpa, in 1821, reported a case of strangulation of the ileum in a perineal hernia. Cooper, in 1828, recorded two cases. Hager, in 1834, described a hernia that followed heavy lifting, in a young woman.

Cloquet, in 1817, reported a case, and Ehner's monograph published in 1887 was an important contribution to the anatomy and etiology of this subject. Macready, in 1893, published his work on hernia and was able to collect only 40 cases of perineal hernia. Of these, 34 were in women and 6 in men.

Moschowitz, in 1918, reviewed the literature and reported a case successfully treated by operation. Chase, in 1922, described an excellent operation and the patient remained cured. Miles, in 1926, made a thorough study of the subject.

and suggested a new classification for these hernias, Chabrut and Menegaux, in 1926 published an important monograph, Bueermann, in 1932, wrote a résumé and was able to find 76 cases in the literature, de Modena, in 1936 reviewed the subject and reported a case. In 1937, McCarty, McGuire and McGuire wrote on the operative treatment, Hall, in 1938, reviewed the literature and collected 83 cases. In 1940, Wilensky and Kaufman proposed a new classification for perineal hernia, and Duschl discussed the treatment of postoperative hernia. Teske, in 1942, wrote on the same subject under the title of "Cocegeal Hernia" and found only two cases in the literature! Meade, in 1942, reviewed the literature and proposed a simple classification for these hernias, Dixon, in 1942, published an excellent résumé of the etiology of perineal hernia, and Jenkins, in 1946, made an extensive review of the literature on postoperative perineal hernia.

It is unfortunate that so many papers on this subject are published under different titles and too often the author does not have the time to review what has already been written, and also that many papers are published on this subject under headings that are seldom used by anatomists.

I believe the term *perineal* or *subpubic* should be restricted to designate those hernia that descend into the labium majus in front of the transversus perinei muscle. These are also classed as anterior perineal hernia. Those hernia descending through the outlet of the pelvis behind the transversus perinei muscle are designated as posterior perineal hernia. Both types of perineal hernia are rare and usually occur in women.

### Anatomy

**Boundaries of the Pelvic Outlet**—The pelvic outlet is bounded in front by the subpubic ligament and the ramus of the os pubis and ischium, behind, by the great sacrosacral ligaments and the tip of the coccyx, and externally, by the tuberosities of the ischia, the rectum, urethra and vagina pass through this outlet. The floor of this space is formed by the levator ani and coccygeus muscles. The inner surface of the levator ani is separated from the viscera of the pelvis and from the peritoneum by the rectovesical fascia, and the outer or perineal surface of the muscle forms the inner boundary of the ischio-rectal fossa. The inner surface of the coccygeus muscle is covered by the rectum. There is a cellular interspace between the posterior free border of the levator ani and the lower border of the coccygeus, this space is the weak point in the perineum, and it is through this gap that most hernias appear. (Fig. 224.)

Ehner, in 60 dissections on the cadaver, found an interstice 47 times between the levator ani and the ischio-coccygeus muscles, and an interspace between the coccyx and the ischio-coccygeus muscle 21 times. Scarpa had previously called attention to interstices in the levator ani muscle.

**Douglas' Pouch or Culdesac**—The rectovaginal culdesac was first described by James Douglas, early in the eighteenth century. The position of the pouch varies being dependent upon the age and sex of the patient and fullness of the bladder and rectum. The presence of this culdesac is one of the principal factors in explaining the occurrence of perineal hernia.

In embryonic life this pouch forms a long canal descending to the perineum. It does not always retrogress but may persist partially or completely when it forms a true hernial sac analogous to the peritoneal canal of congenital inguinal hernia (Rochard). The position of the culdesac is higher

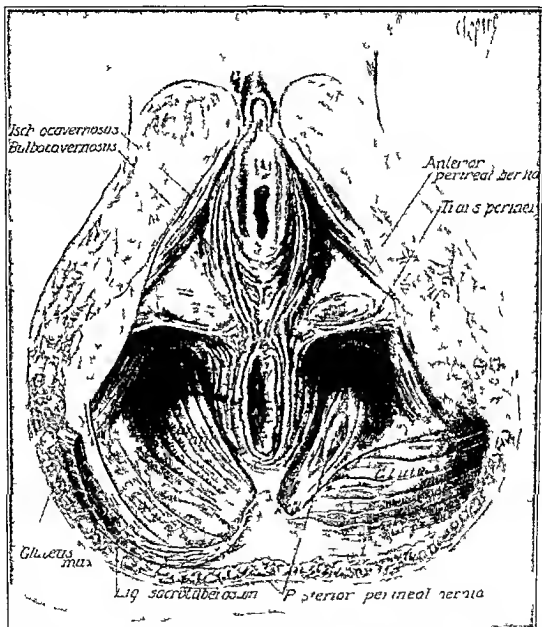


Fig 1—The anatomy of perineal hernia in the female. Showing the points of exit of perineal hernias.

in males than in females. The pouch is elongated from 3 to 3½ inches (7 to 8 cm) when the bladder is full and to 4 inches (10 cm) when the rectum is distended.



Hernias of the pelvic outlet are divided into two varieties by the trans versus perineal muscle, the anterior perineal and the posterior perineal. The occurrence of anterior perineal hernia in men is denied by some writers, in women, it is usually known as hernia of the labium majus, or as pudendal hernia.

**Anterior Perineal Hernia**—Anterior perineal hernia in the female may escape through a rent in the levator ani which may be congenital or the result of trauma. The hernia leaves the pelvis by following the lateral wall of the vagina and passing through the triangle bounded internally by the constrictor vaginae, externally, by the ischioavernosus, and posteriorly, by the transversus perinei. The hernia passes down into the posterior portion of the labium majus, and if it descends no further, it is known as a pudendal or vaginolabial hernia (Figs 225, 226, and 227). Chase has thoroughly discussed the etiology and anatomy of this type of hernia.

Although most writers do not subdivide the anterior perineal hernias or the labium majus or pudendal hernias as they are sometimes called, from an anatomical standpoint, it is most convenient to separate them into the anterior labial and posterior labial varieties.

1 *Anterior labial hernia* passes through the pelvic floor and partly encircles the vagina on its way to the center of the labium majus. This variety is more frequent than the posterior labial hernia.

2 *Posterior labial hernia* leaves the pelvis through the ischiorectal fossa and makes its appearance in the posterior part of the labium majus, near the fourchette.

**Contents of the Sac**—The bladder is most frequently found in anterior perineal hernia. In some of the early cases reported it was very large, encircling the vagina more than halfway, and occasionally it presented diverticula. Intestine is not often found, and when it is present, it is usually due to a sliding of Douglas' pouch between the levator ani and the constrictor vaginae. Congenital labial hernia of intestine alone has been found in young girls, but it is very rare.

**Posterior Perineal Hernia**—Posterior perineal hernia occurs in both men and women but more frequently in women when it is often called "retro uterine hernia," and may be either vaginal or rectal.

1 *Posterior Perineal Hernia in Men*—In men posterior perineal hernia descends between the bladder and the rectum, appearing in the ischiorectal space or in the perineum usually to one side of the raphe.

2 *Posterior Perineal Hernia in Women*—Posterior perineal or retrouterine hernia descends between the rectum and the vagina, and usually makes its exit through a defect in the levator ani or between this muscle and the coccygeus. It frequently occupies the ischiorectal space, and protrudes below the lower border of the gluteus maximus muscle resembling a sciatic hernia in this respect.

If it remains in the retrovaginal septum, it may travel in one of two directions, either behind the vagina, pressing the posterior vaginal wall forward

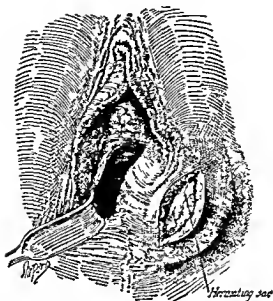


Fig 223—Anterior perineal hernia. When the hernia descends only into the posterior portion of the labium majus, it is known as a 'puddental' or 'vaginolabial' hernia.

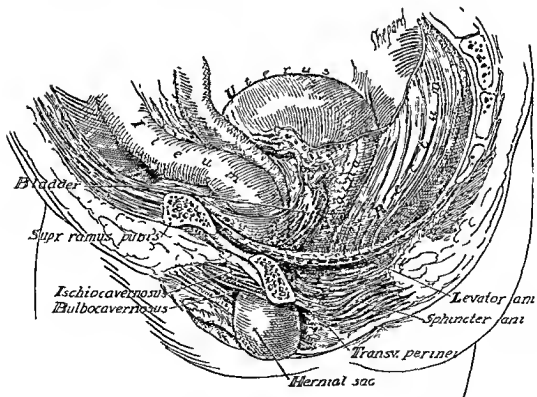


Fig 226—Anterior perineal hernia. Medial section showing the relations of the hernial sac within the pelvis and outside of it.

(elythrocele), or it may burrow in front of the rectum and force the anterior rectal wall back ward causing a bulging in the rectum (hedrocele). If the hernia is large, it may extend into the perineum causing a protuberance at the margin of the anus or it may form a tumor in the gluteal region.

In Papan's case there was a bottle shaped tumor extending from the gluteal region to below the knee and the sac contained omentum, almost all of the small intestine, the lower part of the colon, and the right ovary and tube.

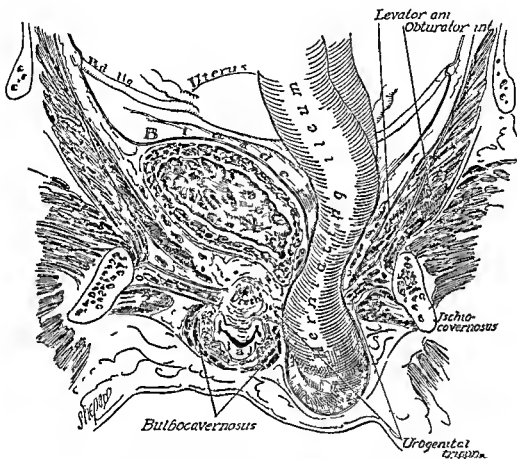


Fig. 227.—Anterior perineal hernia. Transverse section of anterior labial hernia showing the relations of the sac in its descent to the labium majus.

**Contents of the Sac**—Intestine and omentum are most frequently found in the sac. Other viscera that may be present are colon sigmoid rectum bladder cecum appendix uterus, ovary and tube.

### Etiology

**Age**—Perineal hernia occurs most frequently between the ages of forty and sixty years and is most rare between the ages of ten and twenty years.

**Sex**—Anterior perineal hernia almost always occurs in women. Posterior perineal hernia is five times more frequent in women than in men (Eccles).

**Predisposing Causes.**—Congenital predisposition is an important factor in perineal hernia. It may be manifested by defects or malformations in the muscles or fascia, in women by an abnormal descent of the rectovaginal fold of Douglas' pouch, and in men by a relaxation of the rectovesical folds.

The space between the bladder and the rectum in males and between the uterus and the rectum in females is deeper in embryos than in later life. If this cavity persists in the adult there is a definite predisposition to perineal hernia. Scarpa believed that the elongation of the mesentery and the relaxation of the culdesac are important causes. The relaxation of the peritoneum may be due to pregnancy, obesity, old age, or to collections of fluid in Douglas' pouch.

Intestine may become adherent in the culdesac and under the influence of strain or injury it may be forced between the rectovaginal septum. Lipomas developing in this region may descend to the perineum carrying along a peritoneal sac thus favoring the subsequent development of a hernia.

Other predisposing factors are infections involving the pelvic floor, parturition and difficult labor involving tears or lacerations of the muscles and fascia.

**Exciting Causes.**—The onset of the hernia is usually sudden; it may follow a fall as in Pipelet's case or the lifting of a weight as in the cases reported by Scarpa, Hager and Wolff. Henno reported the case of a soldier who fell from a height and struck upon the perineum.

### Symptoms and Diagnosis

Perineal hernia is nearly always reducible. The tumor is soft and tympanic if the sac contains intestine alone and dull on percussion if it contains omentum, bladder or solid viscera. The mass increases in size when the patient stands up or coughs. There may be difficulty in urination if the bladder is in the hernia as in the case reported by Pipelet whose patient was a man with an anterior perineal hernia that was caused by jumping a ditch. The tumor was soft about the size of a hen's egg and the patient could urinate only by bending forward and pressing on the perineum.

Posterior perineal hernias are divided by Berger into two varieties. In one the hernia appears as a uniform bulging into the rectum or vagina and there is no distinct separation between the hernial sac and Douglas' pouch. This variety is frequently mistaken for a simple prolapse of the rectum or vagina. In the second variety the hernia is pedunculated. The sac has a distinct neck and strangulation sometimes occurs. This hernia has been mistaken for a vaginal polypus and excised with disastrous results as in the case reported by Mehelson and Lukin. Following the excision of this supposed polypus the patient became violently ill with vomiting, colic and symptoms of general peritonitis. Death followed in twenty-four hours.

**Vaginal Hernia.**—Vaginal hernia usually appears high up on the posterior wall of the vagina and to one side. The swelling may protrude at the vaginal orifice when the patient is standing and it disappears when lying down. It is usually only slightly painful but it is very uncomfortable, and the tumor tends to increase gradually in size.

**Lateral Peritoneal Vaginal Hernia**—Lateral peritoneal vaginal hernias are very rare. There are only 4 cases in the literature, according to Wilensky and Kaufman, who state that these hernia enter the vagina through the lateral fornices and are subclassified as anterior or posterior, depending on whether their peritoneal openings are anterior or posterior to the broad ligament.

**Rectal Hernia**—In rectal hernia the anterior rectal wall is forced backward into the rectum, the tumor causes constipation, and there is difficulty in defecation. There is a dragging down pain in the rectum, and as the tumor increases in size it may pass beyond the anus and be mistaken for a prolapse of the rectum.

**Strangulated Perineal Hernia**—If the hernia contains intestine, there will be a tender irreducible mass together with constipation, colic, and vomiting. The tumor may bulge into both the vagina and the rectum, as in the case reported by Petrunti, whose patient had symptoms of strangulation with peritonitis. An abscess was suspected, the tumor was opened through the vagina, and gangrenous omentum was found in the sac.

### Differential Diagnosis

There are several conditions that may simulate perineal hernia.

**Abscess**—Abscess presents a fluctuating tumor that is painful, tender and irreducible. Gunz mistook a vaginal hernia for an abscess and incised it, the patient died of peritonitis. Woolbert made the same mistake and his patient recovered.

**Cyst**—Cysts are soft fluctuating, painless and irreducible.

**Hematoma**—Hematoma of the vulva or vagina is usually traumatic, it presents a tender swelling which is blue or purple, and the skin is tense and shiny.

**Lipoma**—Lipoma is usually of slow growth. It is painless, irreducible and can often be lifted up with the fingers. It is freely movable and has no connection with the deep structures.

**Fibroma**—Fibroma, like lipoma, is of slow growth and does not cause symptoms until it is quite large. If it arises from the subperitoneal tissue below and in front of the bladder, it may by traction cause a perineal hernia of the bladder.

**Prolapse of the Vagina and the Rectum**—Prolapse, on vaginal and rectal examination, will disclose a laceration of the rectovaginal septum and a bulging mass in the vagina or the rectum that is not connected with Douglas' pouch. In hernia, the rectovaginal septum will be found intact, the tumor can be reduced into Douglas' pouch, and an impulse can be obtained on coughing. When rectal prolapse and hernia occur in the same patient, the hernia appears as a second tumor situated in front of the prolapsed rectum.

**Inguinal Hernia**—Inguinal hernia which descends into the anterior part of the labium majus, on reduction will pass above the pelvic brim and into the inguinal canal, while an anterior perineal hernia of the labium majus reduces backward toward the uterus, and the inguinal canal is found to be free.

**Femoral Hernia**—*Femoral hernia on reduction passes upward into the femoral canal while perineal hernia reduces backward internal to the descending ramus of the pubis and the tumor can be plainly felt by vaginal examination*

### Prognosis

Perineal hernia causes considerable discomfort and may interfere with the patient's occupation but his life is not in danger unless strangulation occurs. The tumor is usually small. Truss and bandage treatment offer little relief, as they often fail to hold the mass or to check its growth. The best prospect for a cure is offered by abdominal operation. In the presence of strangulation immediate operation is imperative. On account of the difficulty of closing the large opening usually found in these hernias there has been a high percentage of recurrence following the operation. If the muscles are so widely separated that the hernial ring cannot be palpated operation on non-strangulated perineal hernia is usually contraindicated.

When hernia complicates pregnancy the tumor should always be reduced before confinement. There are cases on record in which parturition has been made very difficult by neglect of this measure.

### Treatment

**1 Mechanical Treatment**—Bandage and truss treatment as well as the use of pessaries in vaginal hernias have generally proved unsatisfactory but when there are decided contraindications to operation it is sometimes necessary to employ these appliances.

**2 Taxis**—Reduction of the hernia can usually be accomplished by pressure on the tumor with the patient in the Trendelenburg position. If the tumor protrudes into the vagina or the rectum reduction through the opening in the pelvic floor will be facilitated by digital pressure in the vagina or rectum.

**3 Radical Operation**—Operative treatment of perineal hernia should be undertaken when the general condition of the patient is good and there is a reasonable assurance that the opening can be closed. Sometimes the pain, discomfort and incapacity are so great that surgical intervention is imperative. In case of strangulation immediate operation is indicated to relieve the obstruction and an effort should always be made to close the hernial opening. If prolapse of the uterus or rectum is a complicating factor appropriate treatment should be undertaken to correct the condition after the hernia is dealt with.

There are two routes for operating on perineal hernia: the abdominal and the perineal.

**Abdominal Route**—The abdominal approach is usually the operation of choice because it permits an easier reduction of nonstrangulated hernia and if there is gangrene the intestine can be resected without the necessity of making a second incision as would be required if the perineal route were used. The sac can be dealt with to better advantage and there is a better prospect of closing the hernial opening securely.

The patient is placed in the Trendelenburg position, a median incision below the umbilicus is made, and the hernial opening exposed by free retraction. The hernia is reduced and the sac invaginated by seizing the lower end with a forceps and making traction. If the opening is small, the sac is excised and the muscle edges are freshened and brought together. In large hernias the sac is folded upon itself and sutured over the muscles to reinforce the closure. Sometimes the central portion of the sac is excised leaving an anterior and posterior flap these are widely overlapped and sutured (Fig 228)



Fig 228—Abdominal operation for anterior perineal hernia. The hernia is reduced through the abdominal incision, the sac invaginated and sutured to the peritoneum on a level with the lower end of the laparotomy incision.

**Perineal Route**—The perineal operation should never be used if symptoms of strangulation are present. Although the perineal route is more direct and affords a better view of the hernia than laparotomy, it also presents more difficulties in closing the internal opening.

The skin incision is usually made external to the constrictor vaginae muscle and parallel to it. The ischioanal fossa is exposed by blunt dissection; if the orifice in the pelvic floor is large, the incision can be extended backward to the sphincter muscle and the transversus perinei divided. The hernial sac should be opened very carefully as it frequently contains bladder which is sometimes extraperitoneal. After reducing the hernial contents, the sac is folded on itself by through and through sutures and placed in the internal opening to serve as a pad and to strengthen the line of suture. A plastic operation is carried out by using the muscles and fascia, and the hernial opening closed as securely as possible.

**Vaginal Hernia**—The operation for vaginal hernia proposed by Huguier consists of excising the greater part of the wall of the vagina, followed by a plastic operation to close the opening and to give a firm pelvic floor. In the case reported by Sweetser, a transverse incision was made at the mucocutaneous junction of the perineum, and another one upon the posterior wall of the vagina as far upward as the cervix. The flaps were dissected back, and the hernial sac was found at the level of Douglas' pouch. The sac was continuous with the peritoneum and contained cystic fluid which was evacuated, the sac was ligated and excised, and the levator ani muscles were sutured over the stump. The redundant vaginal wall was excised and the edges were sutured, there was no recurrence.

**Combined Operation**—In certain instances it is necessary to use both the perineal and the abdominal routes in operating for perineal hernia. The perineal incision is used to confirm the diagnosis, to free the adhesions in the sac and to reduce the hernia, the abdominal incision is used to deal with complicating conditions, to close the internal opening, and to anchor the sac and hernial contents at a sufficient distance from the opening to lessen recurrence. The operation is concluded with a plastic repair of the muscles of the perineum.

The best operation is the combined abdominal perineal procedure described by Chase. His case was the thirteenth pudendal hernia operated on and the first patient to remain cured over the years.

Postoperative treatment should be directed along the lines outlined in the chapter on the treatment of inguinal hernia, including weight reduction to lessen the danger of recurrence.

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## CHAPTER XXX

### SLIDING HERNIA

**Synonyms**—Sliding hernia, *hernie par glissement*; dry hernia, landslip or landslide of the large intestine, hernia of the large intestine

**Definition**—A protrusion of large intestine through a normal or abnormal opening in the abdomen or pelvis

While a hernia of the large intestine may escape through any opening in the abdomen or pelvis, this chapter will be restricted to the discussion of the inguinal and femoral varieties. On the right side, the parts usually involved are the cecum appendix and ascending colon, on the left side, the sigmoid and descending colon. The transverse colon is rarely found, except in umbilical and diaphragmatic hernias, while the upper portion of the ascending or descending colon is usually found in lumbar hernia. (These three varieties of hernia of the large intestine are discussed in the chapters on umbilical, diaphragmatic, and lumbar hernia. The very rare varieties of perineal, obturator, and sciatic hernia are also considered in their respective chapters.)

#### Historical

Hernia of the cecum was perhaps first described by Galen. Roussetus, in 1559, stated that he had seen Maupisius expose a cecal hernia during an operation on a bootblack. Geiger, in 1631, stated that cecal hernia occurred most frequently on the right side. Spigelius reported a case in 1645, and in 1680 Blegny remarked upon the rarity of this type of hernia. Johan Otto, in 1688, punctured the cecum in a hernial sac, mistaking it for a hydrocele. In 1732 Arnaud reported a case in a man, sixty years old, with a serotal hernia of twenty years' duration. His description of the operation resembles some of the case reports in modern literature in which the surgeon unexpectedly encounters his first case of hernia of the large intestine. Arnaud wrote as follows: "The intestines were adherent to the hernial sac and to each other and were even gangrenous at several points. I have employed one and a quarter hours in dividing the adhesions and bridles (constrictions) that connected the colon to the hernial sac." In order to finish the operation, Arnaud was compelled to cut away the mass at the internal ring which consisted of the cecum and a portion of the colon and ileum. Of course a fecal fistula followed, but the patient survived.

In 1781 Sandifort recorded a case of congenital serotal hernia in an infant three months old, in which the sac contained ileum, cecum and appendix, the latter being adherent to the testis and to the bottom of the sac.

Wrisberg, writing in 1779, believed the descent of the testis was the cause of these hernias. Petit, in 1790, emphasized the difficulty of reducing hernias of the large intestine because of adhesions. Chopart and Desault, in 1797, stated that they had seen the cecum bared of peritoneum, lying under the integuments

of the serotum Sernin saw this same condition later and named it *enterocèle alystique*, or sacless hernia Tritschler, in 1806, wrote on hernias of the large intestine, but it remained for Searpa, in 1809-1810, to furnish a classic description of these hernias which he divided into two groups

Hotchkiss, in 1909, described the modern operation for sliding hernia Carnett, in 1909, wrote at length on the anatomy of sliding hernia David, in 1923, discussed sliding hernia of the cecum and appendix in children Bevan, in 1930, described an operation for massive hernia Vengerovskiy, in 1935, spoke of the association of appendicitis and hernia of the cecum MacKis, in 1936, Duncan, in 1940, Lamson, in 1940, and Zimmerman and Laufman, in 1942, described the operative treatment of sliding hernia, and Burton and Blotner, in 1942, reviewed the etiology and treatment Sliding hernia of the ovary and tube have been reviewed by Papai and Adam Rogers, in 1947, reported a sliding hernia that involved nearly all of the bladder

### Statistics

I have collected from the literature 800 cases of hernia of the large intestine (not including hernia of the appendix alone) Of these, 765 were inguinal and femoral, 20 were other varieties and in 15 the location was not stated

**Age**—The age of the patients was given in 644 cases Hernia of the large intestine is most common in infants under two years of age and is next in frequency in subjects from forty one to sixty years of age

**Duration of the Hernia**—The duration of the hernia was stated in 200 cases It varied from twelve hours to sixty years in the adults In 31 cases it was congenital, most of these were in infants and children

The table which follows represents a study of 648 cases of inguinal and femoral hernias of the large intestine, and gives the distribution between the two sexes the occurrence on the right and left sides the contents of the sac, and the frequency of sliding hernia

### Anatomy

Ceclal hernia is the most frequent variety of the hernias of the large intestine, and the anatomy of the parasacculal and extrasacculal types has been the subject of considerable controversy between anatomists and surgeons The anatomists are agreed that it is always possible to identify the two fused layers of peritoneum within the abdomen, and that these layers always persist in the extrasacculal or sacless variety On the other hand, many surgeons have reported cases of unquestionable sacless hernia (Fig 229)

The so called "extraperitoneal" or "retroperitoneal" position of the ascending colon, resulting from the fusion of the primitive mesocolon with the parietal peritoneum, has caused most of this confusion Ancel and Cavaillon, as well as other modern anatomists, pointed out that the colon is at no time behind the peritoneum Carnett stated that the fused layers of primitive mesocolon and parietal peritoneum can be separated always in infants and usually in adults and the primitive mesocolon reestablished



I believe the explanation of these hernias is simplified by Carnett's suggestion that the terms *extraperitoneal* and *retroperitoneal* should be reserved for those viscera that lie in contact with the peritoneum but are at no time surrounded by it (kidneys, ureters, bladder, etc.) and that the terms *retroserous* and *extraserous* should be applied to those viscera which have been from a practical standpoint intraperitoneal but have lost their

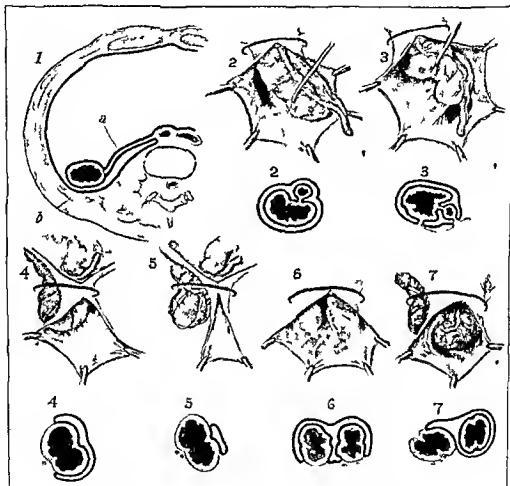


Fig. 29.—The anatomy of sliding hernia of the large intestine

- (1) The fusion of the primitive mesocolon (a) with the parietal peritoneum (b)
- (2) Intrascacular hernia of the free cecum ( ) Mesial section showing relation of the peritoneum
- (3) Beginning sliding hernia of the cecum. The leaflets of the mesocecum diverge to form the sac ( ) Mesial section showing relation of the peritoneum
- (4) Sliding hernia of the cecum. The cecum is outside of the peritoneal sac (extrascacular)
- (5) Sliding hernia of the cecum. The cecum has slipped through the peritoneal ring and remains in the deep cellular tissues and does not bulge into the sac (extrascacular) ( ) Mesial section showing relation of the peritoneum
- (6) Extrascacular sliding hernia of a loop of colon ( ) Mesial section showing relation of the peritoneum
- (7) Intrascacular hernia of cecum and extrascacular hernia of descending colon ( ) Mesial section showing relation of the peritoneum

serous layer on one or more aspects as a result of fusion (ascending and descending colon pancreas duodenum etc.)

**Cecum**—The cecum is a blind pouch with its fundus directed downward and its open end upward. It is usually about  $2\frac{1}{2}$  inches (6.25 cm) in length and 3 inches (7.5 cm) in breadth. Four types have been described by Treves. The cecum is nearly always entirely surrounded by peritoneum. In 5 to 6 per cent of the cases the peritoneal investment is incomplete leaving a small area on the upper end of the posterior surface uncovered and connected to the iliac fossa only by connective tissue.

**Mesocolon**—The mesenteries of the large and small intestines are continuous at first and are attached to the spine. When the intestinal loop rotates around the superior mesenteric artery it carries the beginning of the large intestine and its mesentery to the right across the duodenum. This rotation partially cuts off a fan shaped portion of the general mesentery that lies within the convexity of the loop and this portion later on forms the mesentery proper in the adult.

**1 Cecum**—The cecum has no mesentery because the mesentery of the ileum passes direct to the ascending colon leaving the cecum and the appendix free and entirely surrounded by peritoneum.

**2 Ascending Colon**—When the ascending colon reaches its position in the right iliac fossa the posterior layer of its mesentery along with the layer of parietal peritoneum behind the mesentery degenerates into areolar tissue and the two fuse together thus forming the attachment of the ascending colon to the posterior abdominal wall. Sometimes the lower quarter or third of the ascending colon is covered by peritoneum. As a rule only about two-thirds of the circumference of the upper part is invested by peritoneum.

**3 Transverse Colon**—The transverse colon is completely surrounded by peritoneum and is attached to the transverse mesocolon. It is found in umbilical, ventral and diaphragmatic hernias rarely in hernias of the lower abdomen or pelvis.

**4 Descending Colon**—The descending colon is often attached to the posterior abdominal wall and not covered behind by peritoneum. Treves found a descending mesocolon 36 times in 100 examinations. Lesshaft found a mesocolon in only one out of 6 subjects. Symington maintained that the loose lax peritoneum is often mistaken for a mesentery.

**5 Sigmoid**—The sigmoid usually has a mesentery and in this case it is entirely surrounded by peritoneum. Sometimes the upper portion of the sigmoid is closely adherent to the left iliac fossa as far as the brim of the true pelvis. When there is a descending mesocolon the sigmoid nearly always has a well-developed mesocolon, the sigmoid is freely movable and it is easy for it to enter a hernial opening especially on the left side. Treves found the mesocolon in a hundred subjects as follows:

Ascending mesocolon only	12
Descending mesocolon only	97
Ascending and descending mesocolon	14
No ascending or descending mesocolon	59

### Pathology

Hernias of the large intestine are divided into two varieties congenital and acquired

**1 Congenital Hernias**—The congenital hernias include almost all those with complete sacs. They resemble ordinary hernias in that the cecum has a mesocolon and descends into a preformed sac. The cecum is entirely covered with peritoneum, it is movable and can be easily drawn into the sac. Besides the cecum the sac may contain the appendix, ascending colon, sigmoid, descending colon, transverse colon, omentum, small intestine or other viscera.

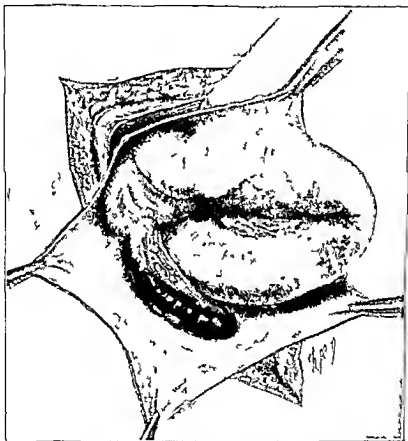


Fig. 230.—Right inguinal hernia of the cecum, appendix and ascending colon. The appendix is gangrenous.

Orr found a sliding hernia of the terminal ileum alone. A loop of terminal ileum, about one foot long, formed one wall of the hernial sac. Inflammation often develops early, and intrasacculi adhesions cause irreducibility (Fig. 230).

Adhesions between the cecum and the testis may be responsible for congenital cecal hernia in certain cases. The first cases of embryologic attachment between the cecum and the testis was observed by Sandifort. Shortly after this

case was reported Wrisberg advanced the theory that the descending testis could pull the cecum into the inguinal canal by its traction on the plica vascularis

**2 Acquired Hernias**—Acquired hernias include those in which the sac is partially or completely attached

*a Simple Acquired Hernia*—In simple acquired hernia the cecum is entirely covered by peritoneum and lies free in the sac the same as an enterocele or an omentocele

*b Sliding Hernia*—Sliding hernias of the cecum are the most common variety and the most difficult to deal with from an operative standpoint In order for the cecum to become extraperitoneal or retroperitoneal the layers of the primitive mesentery would have to be separated before the cecum could enter the subperitoneal tissues and this of course is an impossibility For this reason I prefer to classify hernias of the large intestine according to their relation to their serous covering and not according to their peritoneal relation the latter classification is inaccurate and has led to considerable confusion in the past

**Intrasaccular Hernia (Hernia With Complete Sac)**—Intrasaccular hernia has a sac formed from the parietal peritoneum that surrounds the peritoneal covered cecum The cecum may enter the sac as a result of a ptosis of the colon because of relaxation of the ligaments of the colon or because the colon or cecum has a long mesentery This mesocolon may appear to be inserted into the sac wall The cecum is usually elongated and directed downward and inward

The mesentery may be long or short and contains the vessels and nerves that supply the intestine When the mesentery is attached to the sac it constitutes the 'natural fleshy adhesion' of Scarpa and is the cause of the irreducibility of the hernia This mesentery cannot be cut because it furnishes the blood supply to the intestine Intrasaccular hernias are usually easily reduced while the parasaccular and extrasaccular varieties are irreducible or partially so

**Parasaccular Hernia (Hernia With Incomplete Sac, Hernia With Sac Partially Attached)**—Parasaccular hernia is a variety in which the intestine lies behind the walls of the sac usually to the outer side The cecum is covered by peritoneum on its anterior and internal surfaces this covering also forms the posterior and external walls of the sac and it is continuous with the rest of the sac The entire sac was originally a portion of the parietal peritoneum

*1 The Cecum Appears to Have Been Misplaced in Sliding*—Its superior portion may point toward the abdomen with its base directed downward or it may appear to rotate forward on its longitudinal axis so that its adhesion is in front Rochard stated that it is the serous covering of the intestine in the hernia which is incomplete and not the sac itself If the ordinary hernia incision over the most prominent part of the tumor is employed the cecum or sigmoid may be exposed and the serous covering mistaken for the sac



Parasaccular hernia differs from ordinary (or intrasaccular) hernia in that it has a layer of parietal peritoneum closely adherent to a layer of visceral peritoneum covering the intestine on one side

**2 Hernia by Basculation (*Hernie par Bascule* Rolling Chair Hernia)**—Hernias by basculation are those in which the ascending colon is first to descend and draws the cecum along with it. That portion of the cecum attached to the colon is the first to enter the hernia while the base may remain in the abdomen above the hernial ring or finally descend as the mass becomes larger. The base of the cecum forms an angle with the colon hence the term 'basculation'. When the cecum has a mesentery and retains its peritoneal covering in the hernia sac it is of the intrasaccular variety; if the cecum slides into the hernia and loses a part of its serous covering it becomes parasaccular, and if it is deprived of all of its serosa it becomes a sacless hernia.

**Primary and Secondary Sliding Hernia**—The sliding of the cecum may be primary when the cecum enters the sac first or secondary, when the ileum or ascending colon precedes the cecum and draws it into the sac. Scarpa first called attention to this secondary form.

**Extrasaccular Hernia (*Sacless Hernia* *Hernia Without a Sac* *Hernia With Sac Completely Detached*)**—Sacless hernias are very rare and only a few cases have been reported. I collected 14 cases from the literature. The intestine enters the hernia without its serous covering and lies in the cellular tissue.

Traumatic sacless hernia with the intestine escaping through a rent in the parietal peritoneum is probably more frequent than the spontaneous variety. It is possible that some of the reported cases of sacless hernia were in reality parasaccular; it is easy to overlook a small peritoneal diverticulum or sac located near the internal ring.

**Sigmoid Flexure**—The sigmoid flexure is situated in the left iliac fossa and is 13 to 17 inches (32.5 to 42.5 cm.) long. It is divided into two parts known as the iliac colon and the pelvic colon. It is retained in position by the sigmoid mesocolon.

The lower part of the iliac colon or the portion at the iliopectic junction is the part usually found in hernia of the sigmoid. Because the sigmoid usually has a mesocolon parasaccular hernias are infrequent and sacless hernias very rare. Because of the size of the sigmoid it does not enter a hernial opening as often as the cecum does. The sigmoid requires a large hernial opening and when it is in the sac alone it presents a double loop or double gun barrel appearance while the cecum appears in the sac as a single loop.

**Bilateral Hernia of the Large Intestine**—Bilateral hernia of the large intestine is very rare and only a few cases have been reported.

**Changes in Position of Other Structures**—Very rarely the aorta or inferior vena cava bends slightly toward the side of the hernia. Apparently this is due to traction on the mesenteric vessels caused by the hernia. Tuffier reported several cases in which ptosis of the kidney occurred on the same side with the hernia.

### Etiology

The principal predisposing causes of hernia of the large intestine are age and sex. These hernias usually occur in middle aged or elderly men, most commonly on the right side and nearly always in the inguinal region.

**Age**—Hernias of the large intestine are most frequent in infants under two years of age, and next in frequency in subjects from forty one to sixty years of age.

**Sex**—Hernias of the large intestine almost always occur in men. The following table shows the distribution between the two sexes, the occurrence on the right and left sides and the frequency of sliding hernia, in 648 of the cases I collected from the literature.

	MALE	FEMALE	RIGHT	LEFT	RIGHT SLIDING	LEFT SLIDING
Inguinal	578	33	415	205	56	—
Femoral	6	29	29	2	0	0

**Frequency**—It is impossible to say how common hernias of the large intestine are, because only the irreducible or strangulated ones are reported, and many of the reducible hernias are not even diagnosed at operation.

Thurston stated that right sided hernias of the large intestine are very common in India.

I found sliding hernia 221 times in 8044 cases of hernia collected from the literature.

Lardennois and Okunevsk stated that 40 per cent of the strangulated hernias in the newly born and 27 per cent of those in children contain large intestine, usually the cecum while 3 per cent of the simple hernias in children and 6 per cent of those in adults contain a portion of the large intestine.

**Site of Hernia**—The usual points of exit for hernias of the large intestine are the inguinal femoral umbilical ventral diaphragmatic perineal obturator and sciatic openings. (Only the inguinal and femoral hernias are considered here, as the others are dealt with in their respective chapters.)

In 650 cases I collected from the literature 412 were right inguinal, and 205 left inguinal, 29 right femoral and 2 left femoral. 2 were bilateral.

**Congenital Hernias of the Sigmoid**—Hernias of the sigmoid flexure are rarely congenital, even when the mesocolon is well developed. This fact is probably due to the large size of the sigmoid, of 117 hernias of the sigmoid in my series only 4 were congenital. It is exceptional for adhesions to exist between the cecum or sigmoid and the sac wall in infants and children.

**Anatomic Causes**—The following anatomic factors act as the principal predisposing causes of hernia of the large intestine.

- 1 Abnormal position of the bowel
- 2 Unusual length of the peritoneal attachment of the intestine
- 3 Distention of the intestine
- 4 The descent of the ileum into a hernia may draw the cecum, appendix and ascending colon after it.

5. An appendix adherent in a hernial sac may drag down the cecum and the ascending colon.

6 Congenital causes, such as adhesion of the cecum or sigmoid, to the descending testis.

Finally, more than one of the above factors may exist in one subject.

**Sliding Hernia.**—Sliding hernias are due to a slipping of the posterior parietal peritoneum on the underlying cellular tissue. The peritoneum slides into the internal ring, carrying with it the attached loop of large intestine. As a rule, true sliding hernias of the descending colon and sigmoid occur only on the left side; and sliding hernias of the ascending colon and cecum are found only on the right side. When these viscera are found on the sides opposite from their normal positions, it is nearly always due to a loosening of their attachments, to an abnormally long mesocolon, or to an elongation of the bowel itself. Bilateral sliding hernias are very rare.

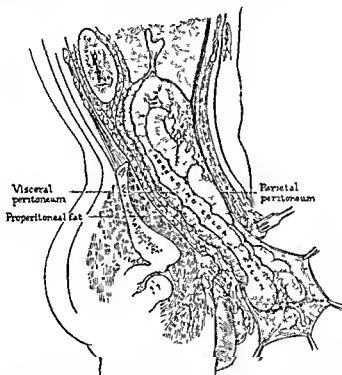


Fig. 231.—Sliding hernia. A lateral longitudinal section to show that excessive properitoneal fat hastens the descent of a sliding hernia of the cecum and colon.

The principal stages of sliding hernia are the following: sliding, ptosis, descent, basculation, and deperitonization. The sliding or gliding involves the cecum or sigmoid and its colon and mesocolon, with their peritoneal covering. The intraabdominal pressure is one of the most important factors influencing the sliding of the intestine toward the hernial orifice. Sometimes there is an accompanying ptosis of the kidney on the same side as the hernia, as well as a deflection of the inferior vena cava and of the aorta, toward the same side.

*Ptoſis of the large intestine or other viscera is often found in very large hernias. Congenital hernias of the large intestine are often due to the dragging of the mass of omentum into the hernial sac. The traction exerted by adherent omentum or intestine in the sac is also a causative factor. Visceroptosis is certainly not an important predisposing cause of hernia of the large intestine if it were these hernias would be more common in women. (Fig 231)*

The descent of the hernia once it has reached the ring is progressive being aided by the relaxation of the ligaments of the colon and the weight of the intestinal contents. This regular constant pull or pressure gradually forces the bowel down to the hernial ring and through it in contradistinction to the exciting causes of ordinary hernia namely straining lifting trauma etc.

**Causes of Left-Sided Cecal Hernia**—Left sided cecal hernias are uncommon and they are nearly always intrasaccular. Parasaccular and extrasaccular (sacless) hernias are very rare. Left cecal hernias are probably always due to congenital transposition of viscera or to malposition of the cecum combined with adhesion of the cecum to the parietal peritoneum on the left side.

Other causes of cecal hernia are a long ascending mesocolon traction from the ileum adhesions between the cecum and omentum or small intestine failure of the cecum to rotate from the left side to the right side in embryonic life ptosis of the large intestine scrobosis and kyphosis.

**Right-Sided Hernia of the Sigmoid**—Right sided hernia of the sigmoid occurs occasionally and may be due to one of the following causes an abnormally long mesocolon congenital transposition of viscera traction from adhesions between the sigmoid and omentum or intestine already in the sac enteroptosis scoliosis and kyphosis.

### Symptoms and Diagnosis

**Functional Symptoms**—The functional symptoms of hernia of the large intestine are similar to those of hernia of the small bowel and are not well defined if the hernia is reducible. When the cecum sigmoid or colon is in the hernia and is irreducible the symptoms are more marked and consist of constipation attacks of partial obstruction pain in the hernial mass and colicky pain with occasional attacks of diarrhea.

When the symptoms are not well defined the diagnosis is very difficult and for this reason the majority of cases reported have not been diagnosed prior to operation.

**Objective Signs**—In the infant the tumor is usually large out of proportion to the size of the child and oval in shape. In the adult it is also very voluminous and tends to increase progressively in size. It is usually pyriform or oval in shape and occasionally bilobular. The neck of the sac is nearly always large and is distended by the thick pedicle of the sac contents. As a rule the signs are those common to all intestinal hernias. It is possible only occasionally to recognize the sac contents by palpation. Sometimes the appendix can be felt in children and it can be distinguished in adults in rare instances when the hernial coverings are very thin. The appendices epiploicae are sometimes palpable.

Sometimes the examiner can make out an abnormally small amount of large intestine in the iliac fossi by means of palpation and percussion. Reduction of the hernia is usually accompanied by pain and reduction becomes more difficult as the hernia increases in size. Irreducibility may be due to the formation of inflammatory adhesions in the sac, or to the descent of the mesocolon into the hernia. The roentgen ray is a valuable aid in diagnosis and will sometimes succeed when other methods fail. Morestin used it successfully and Marchetti was able to diagnose a scirrhous hernia of the sigmoid before operation from the roentgen ray pictures.

In boys a congenital hernia of the large intestine that has been reduced can often be reproduced by traction on the testis.

**Complications**—The principal complications of hernia of the large intestine are intestinal obstruction, strangulation and peritonitis in the hernial sac. The rare complications are a hydrocele in the sc, intussusception of the small intestine, hematoma, tuberculosis and malignancy of the colon in the hernia.

**1 Obstruction**—Obstruction may occur in a partially reducible hernia or in an irreducible one. It is usually preceded by increased pain, colic, and other symptoms of obstruction referred to the mass which is often very large and has sometimes lost its right of domicile. The hernia is nearly always sensitive to the touch, quite firm and often tympanitic on percussion. Nausea and vomiting are common and usually do not subside until the bowels act. The attacks of pain and obstruction have a tendency to recur and it is sometimes impossible to distinguish obstruction from the symptoms of beginning strangulation.

**2 Strangulation**—On account of the large hernial opening, strangulation is rare, occurring much less often than obstruction. The symptoms are at first mild, perhaps attracting little attention. Their course is progressive, nausea and vomiting increase and if the entire lumen of the intestine is occluded there is absolute constipation and no gas passes the obstruction. The patient's life depends on prompt diagnosis and immediate operation. In partial enterocoele constipation is not complete and the symptoms are less severe, but there is always the danger of gangrene of the strangulated intestine with fatal peritonitis.

**3 Peritonitis in the Hernial Sac**—Peritonitis is the natural sequela of untreated strangulated hernia. Infection occurs early and inflammation rapidly spreads involving other sac contents. The peritonitis is usually confined to the sac by adhesions at the neck of the sac. However, because of the large hernial opening, the infection spreads to the abdomen more frequently than in isolated hernia of the appendix. When the appendix is alone in the sac the ring is usually very small. If the patient lives, hernial peritonitis generally terminates in abscess formation and a fecal fistula.

### Differential Diagnosis

Hernia of the large intestine must be differentiated from other varieties of hernia, especially from hernia of the small intestine, omental hernia, hernia

of other abdominal and pelvic viscera, and hydrocele (The differential diagnosis of these is taken up in the chapter on differential diagnosis of inguinal hernia) The surgeon should be on his guard for hernia of the large intestine in all voluminous hernias, when the hernia is incompletely reducible, when the patient cannot tolerate a truss, when there is no gurgling on reduction because of the large hernial rings and when there are signs of considerable gas in the bowel within the sac

**Bladder**—Hernia of the large intestine is sometimes mistaken for hernia of the bladder, especially if the mass is small. Urinary symptoms are usually present in bladder hernia and the irreducible portion of the tumor lies to the inner side of the reducible part, while in hernia of the large intestine, the irreducible portion is on the outer side of the reducible part

### Prognosis

The prognosis of hernia of the large intestine is more serious than that of hernia of the small intestine. Truss treatment is usually unsatisfactory, and on account of the large size of the hernial opening it is difficult or impossible to keep the hernia reduced. Besides being the source of considerable pain and discomfort, the volume of the hernia and its tendency to become irreducible seriously affect the general health and earning capacity of the subject. Operation is the treatment of choice. Hernia of the sigmoid flexure usually presents more operative difficulties than hernia of the cecum.

I collected from the literature 528 cases of hernia of the large intestine treated by operation. The large intestine was reduced in 505 cases with 469 recoveries and 36 deaths, and it was resected in 23 cases with 10 recoveries and 13 deaths. The appendix was excised in 150 cases, with 8 deaths, and it was reduced in 28 cases with two deaths later from appendicitis.

There is little prospect of cure from truss treatment even in infancy and early childhood on account of the large hernial ring and for this reason operation is to be advised as early as possible.

**Anesthesia**—The prognosis from an operative standpoint depends largely on the choice of the anesthetic. Local anesthesia not only lowers the mortality rate in the young and robust, but it also offers to the aged and to the otherwise handicapped patient a prospect of cure without the dangers and discomforts of general anesthesia. For aged patients, if local anesthesia is not available, spinal anesthesia is to be preferred to general anesthesia.

The operative treatment of intrasacccular hernias of the large intestine presents no unusual difficulties, and the prognosis is as good as that in massive hernias of the small intestine. In the former, however, there is greater danger of recurrence, because of the large hernial opening and the tendency of the large intestine to descend and break through the closed hernial ring, unless the prolapsed intestine is anchored to the abdominal wall by a colopexy.

The operation for parasacccular and extrasacccular (sacless) hernias presents unusual difficulties in that it is difficult to locate the sac. There is great

danger of wounding the intestine or its blood supply, and the dissection and reduction of the intestine are tedious and complicated. The prognosis of strangulation is particularly grave, fortunately the condition is rare.

### Treatment

The radical operation is the treatment of choice for hernia of the large intestine. The indications for mechanical treatment are considered in the chapters on inguinal and femoral hernia and it is sufficient to state here that, as a rule, truss treatment or other palliative measures are unsatisfactory on account of the large hernial opening. Even in infants there is a small prospect of cure by mechanical means.

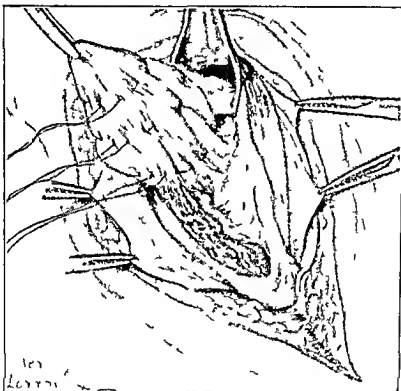


Fig. 232.—Nonadherent intrasacculary hernia. The sac is freed but not opened. Three purse string sutures are placed at varying levels and tied as the sac is inverted.

**Preoperative Treatment**—The preoperative treatment of massive hernias of the large intestine is very important especially when they are irreducible and have lost their "right of domicile" in the abdomen. (This subject is discussed in detail in the chapter on umbilical hernia.) It is only necessary to remark here that if this preoperative treatment is neglected, the mortality will be unnecessarily high. Of course in strangulated hernia immediate operation is imperative.

**Contraindications to Operation.**—The contraindications to operation on hernias of the large intestine are about the same as those that apply to massive inguinal hernias. Usually the operative treatment is not to be advised when the hernia is voluminous when it has been irreducible for a long time and has lost its "right of domicile" in the abdomen and when the patient is very old, or when the hernia is complicated by advanced cardiovascular, renal or pulmonary lesions. Certain of these contraindications however do not maintain when local anesthesia is employed.

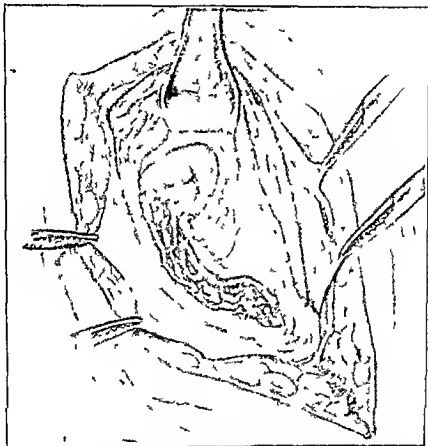


Fig. 233.—Nonadherent intrasaccul hernia. With the sac reduced the internal ring and the wound are closed as in direct inguinal hernia.

**The Radical Operation.**—From the standpoint of the operative treatment it is most convenient to divide hernias of the large intestine into two groups.

**1 Intrasaccul Hernia.**—The operation for nonadherent hernias both in infants and in adults, is similar to the one already described for direct inguinal hernia. After opening the hernial sac the contents are inspected and their attachments noted. As the colon usually forms only a portion of the posterior wall of the sac, the surgeon proceeds to dissect the sac and its intestinal floor from the spermatic cord. This dissection must extend well within the abdominal ring so that the sac and colon can be completely reduced into the abdominal



cavity. Next he places a purse string suture around the neck of the sac, quite high on the anterior surface and then proceeds posteriorly with caution, stitching as close to the peritoneal reflection on the colon as possible and yet not interfering with the blood supply. The colon is pushed upward as the purse string is tightened and tied. The wound closure is then completed as in an ordinary operation for direct inguinal hernia using fine silk or cotton interrupted sutures. (Figs. 232 and 233.)



Fig. 234.—Adherent parasacular and extrasacular hernia. The sac is identified and opened along its anterior border and a purse-string suture is placed inside the sac. The colon is pushed upward as the suture is tied. The wound is closed as for direct hernia.

**2 Parasacular and Extrasacular (Sacless) Hernia**—The same general principles of operation that apply to other hernias hold good for adherent hernias. The incision should be large enough so that the operator can see each structure clearly before he cuts it. It is often difficult to find the sac, and unless the possibility of a sliding hernia is borne in mind there is danger of incising the intestine in mistake for the sac. As a rule in left-sided inguinal hernias the sac is found behind and to the outer side of the mass and in right

sided hernias it is usually situated in front and to the inner side. The possibility of an extraperitoneal bladder hernia is always to be thought of, and there is a remote chance that the extrasacculary intestine may have rotated forward to a position in front of the sac. The sac should be opened along its anterior border and a purse string suture placed inside the sac. The colon is pushed upward as the suture is tied. (Fig. 234.)

In sacless hernias the peritoneal covering is absent and the muscular coat of the intestine is more easily recognized than the fused peritoneal covering of the extrasacculary hernia. Sometimes the intestine can be recognized by its thick red wall which bleeds easily when cut and is frequently covered with a layer of fat. However inflammatory changes may make the intestine very difficult to identify.

**The Hotchkiss Operation**—If the sac cannot be positively identified after freely exposing the mass at the internal ring the hernia incision should be prolonged upward beyond the internal ring and the abdomen opened above the hernia. This hemolaparotomy incision permits the operator to inspect the hernia from within the abdomen to locate the small sac which is nearly always present and in some instances to withdraw the loop of colon from the hernia.

**Locating the Sac**—When the hernia is identified it should be opened high up as near the neck as possible because if the sac is small this incision gives the best chance of finding it. To locate the sac with the least trauma to the intestine a thin place in the suspected sac should be selected and held up to the light to ascertain if it is transparent. Sometimes the presence of intestine can be determined by rolling the two walls of the suspected sac between the thumb and the fingers.

**Freeing the Adherent Intestine**—The sac should be incised along its anterior surface because the nutrient vessels usually lie behind the intestine. After the extent of the intestinal adhesions both inside and outside of the sac is determined the colon is located from a point above the neck of the hernia working from above downward, an attempt is made to find a line of cleavage so that the intestinal loop can be freed along with its mesentery. In case inflammatory adhesions obliterate the line of cleavage it may be necessary to continue the dissection downward entirely in the deep cellular tissues so as to avoid injury to the blood supply of the colon which is extrasacculary, being behind and to the inner side of the intestine.

The sac must not be separated from the colon as this would destroy the blood supply and gangrene would follow. Before resecting any part of the sac, it should be held up to the light to determine whether or not it contains vessels. In operating on hernia of the large intestine it is sometimes possible to identify the large bowel as it is darker in color than an ordinary hernial sac and its distal end can be traced back into the abdomen.

**Reducing the Intestine**—After the loop of intestine has been freed it is usually a simple matter to return it to the abdominal cavity especially if the

patient is placed in the Trendelenburg position. Should the intestine be torn or wounded, the rent should be repaired, and if there is gangrene, the necrotic area must be resected.

*"Hernie par Bascule"*—In reducing hernias by bascule, involving the colon and cecum or the colon and sigmoid the part that came down last should be reduced first. The colon is reduced by making pressure upward and forward on the posterior surface of the hernia, followed by pressure downward on the anterior surface. Finally, the cecum or sigmoid is reduced.

*Reconstruction of the Mesocolon*—When conditions permit, some surgeons advise reconstructing the mesocolon either with or without fixation to the abdominal wall. After resecting a portion of the sac, a mesocolon is formed by turning the edges of the parietal peritoneum over the intestine and uniting the flaps by a few interrupted sutures. Great care must be taken to avoid wounding the blood vessels that lie beneath the inner flap. After reducing the hernia the neck of the sac is ligated, the stump carried upward beneath the peritoneum and finally fixed by a suture passed through the muscles (see treatment of inguinal hernia).

*Cecopexy and Colopexy*—A majority of surgeons employ some method to fix the mobile intestine in the iliac fossa. When the internal ring is widely dilated, it is sometimes possible to retract it upward and anchor the prolapsed cecum or colon satisfactorily without having to make a second incision for this purpose. (Fig 235)

The method of colopexy described by Lenormant is one of the best. The point of fixation is as high as possible above the hernial opening, the distance depending on the length of the loop of colon. At this point, a flap of parietal peritoneum about 4 inches (10 cm) long and 2 inches (5 cm) wide is resected, its long axis running downward and inward. The colon with its sac attached is turned upward so that its lowest point is opposite the highest point of the denuded area. With the colon in contact with the deperitonealized surface a suture is passed between the border of the mesentery and the inner edge of the parietal peritoneum. The free border of the colon is sutured to the outer edge of the parietal peritoneum, taking a good bite in the iliac fascia. I believe that it is sufficient to denude an area of parietal peritoneum only half as large as advised by Lenormant, for the reason that the amount of colon in a hernia compared to the amount involved in prolapse of the rectum is very small and it is for the latter condition that his operation was originally devised. (Fig 236)

The operation devised by Savariand is comparatively simple and can be carried out more quickly than some of the other procedures. After opening the hernial sac and identifying the contents, the intestine, sac and vessels are detached *en masse* and the edges of the sac brought over the raw area and stitched together with a running suture. The closed sac is pressed back and invaginated into the abdominal cavity, like a finger of a glove.

*The Sac*—If the sac is small, I believe that no attempt should be made to resect a portion of it, but the whole of it should be everted over the raw area

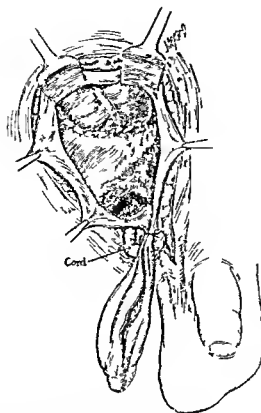


Fig. 235 —Operation for sliding hernia of the large intestine. Cecopexy. To lessen the danger of recurrence it is usually advisable to anchor the mobile colon in the iliac fossa as high as possible above the hernial opening.



Fig. 236 —Colopexy. Mesial section to show the colon anchored in the iliac fossa.

of the intestine to form a new mesocolon, when the sac is large, the edges may be trimmed, inverted over the large intestine and sutured. The principal steps of this operation are as follows:

After the sac is freed from the cord structures, it is cautiously incised anteriorly and the opening enlarged, to expose the bowel content. The sac is divided with scissors on its posterior surface to a point within  $\frac{1}{2}$  inch (1.25 cm) of the lowest point of the intestine almost to the lowest attachment of the mesocolon on the posterior wall. From this point the incision is continued

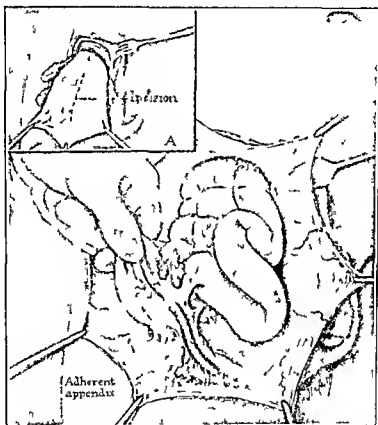


Fig. 237.—Operation for sliding hernia of the large intestine. The sac should be opened along its anterior surface because the nutrient vessels usually lie behind the intestine.

along either side of the bowel as high up as the neck of the sac keeping at least  $\frac{1}{2}$  to  $\frac{3}{4}$  inch (1.25 to 2 cm) from the lateral walls of the intestine. The colon is grasped at its lowest point and pulled forward to evert the split hernial sac and turn its peritoneal surface outward thus forming two flaps which are sutured together to cover the raw posterior surface of the intestine and to form a new mesocolon. The two edges of the divided sac are sutured together behind the bowel which now floats free in the sac and can be reduced easily into the abdomen. The sac is inverted through the hernial ring and the opening closed (Figs 237, 238 and 239).

If the intestinal loop is long this operation has two distinct disadvantages namely the danger of kinking and obstruction in the reduced intestine and the possibility of torsion or constriction of the intestinal blood supply as it runs between the layers of the new mesocolon. For these reasons the methods that pull up the colon and fix it to the posterior abdominal wall are to be preferred.

*The Testis*—The spermatic cord and testis should never be sacrificed in order to make a complete closure of the hernial opening. If the cord cannot be isolated the sac should be left in position so as not to injure the vessels.



FIG. 338.—Operation for sliding hernia of the large intestine. The intestinal loop and its mesentery have been freed and the sac trimmed along either side of the bowel as ligatures are placed at the neck of the sac. The peritoneal edges of the trimmed sac are being sutured together behind the bowel to form a new mesocolon.

*Closure of the Hernial Opening*—If the hernial ring is small it may be closed by Cooper's ligament operation. If it is very large it is better to use one of the other operations I have described for large direct hernias in the chapters on inguinal hernia. Mackay overlapped the lower flap of peritoneum well up on opposite side of sigmoid to the peritoneal wall above it to give two layers of peritoneum in front of the sigmoid. Bevan invaginated the hernial sac into the peritoneal cavity with two to four purse-string sutures of silk or

cotton. This gives an excellent closure of the peritoneal sac and is adapted to all sliding hernias except the very large ones (Fig 240)

*Operative Complications*—Operative complications in adherent hernia of the large intestine are more frequent than in simple hernia. Injury to the intestine is always serious and must be recognized immediately and taken care of. Interference with the blood supply by any of the following accidents is also to be guarded against:

- 1 The separation of the vessels from the intestine while attempting to dissect out the sac
- 2 The inclusion of the vessels in the sutures while reconstructing the colon
- 3 The inclusion of the vessels in the suture line that approximates the edges of the sac over the raw area
- 4 The constriction of the vessels by the sutures of the colopexy



Fig 239—Operation for sliding hernia of the large intestine. The stitching of the new mesocolon has been completed. The two edges of the divided sac are sutured together behind the reduced bowel. The sac is inverted through the femoral ring and the opening closed by one of the methods described under the treatment of direct inguinal hernia.

**Strangulated Hernia of the Large Intestine**—Strangulated hernia of the large intestine is infrequent. The outlook is particularly grave because the subject is usually in poor health. The hernia is often very large and the treatment of strangulated adherent immobile large intestine is much more difficult than the treatment of strangulated small intestine.

In case intestinal anastomosis by resection and suture or by means of a Murphy button cannot be carried out, it may be necessary to make a fecal fistula and complete the operation at a later time (see strangulated hernia).

**Recurrence**—Recurrence after operation for hernia of the large intestine is very common because of the large hernial opening, the massive size and

frequent irreducibility of the hernia, and the tendency of the colon to slip down again (Some of the recurrences after ordinary hernia operations are due to a sliding hernia that was not recognized at the first operation)

Recurrence is lowest when the colon is anchored to the abdominal wall by colopexy, and the hernial opening closed by one of the methods devised for very large openings. The ordinary operation for indirect inguinal hernia is



Fig. 240—Bevan's operation. The sac has been freed from the scrotum and the inguinal canal. The nonperitoneal surface of the intestine is shown before the sac is invaginated into the peritoneal cavity, and the hernial opening closed with three or four purse string sutures.

insufficient. Some surgeons advise castration or placing the testis within the abdomen so as to close the opening completely. These practices are never justifiable and cannot be too strongly condemned.

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## CHAPTER XXXI

### HERNIA OF THE VERMIFORM APPENDIX

**Synonyms**—Appendicocoele, appendical hernia

**Definition**—*Hernia of the vermiform appendix is a protrusion of the appendix through a normal or an abnormal opening in the abdomen or pelvis*

Appendical hernia is not common, being about as frequent as bladder hernia. Both of these varieties are most often found in subjects past middle life, and the appendix is usually accompanied by the cecum, omentum, or small intestine. On the other hand isolated hernia of the appendix is found most frequently in infants under two years of age. (Hernia of the appendix is sometimes found in the internal fossae, usually in the pericecal fossa, this variety of appendical hernia is considered in the chapter on internal hernia.)

Ceco appendical hernias, which include those cases in which the principal symptoms are referred to the cecum, and the appendix merely accompanies the latter into the sac, are discussed in the chapter on hernia of the large intestine.

#### Historical

The appendix was first distinguished by Berengerius Carpus in 1524, described by Vesilius in 1543, and by Lallopius in 1560. In 1561 Vidus Vidius gave it the name of appendix vermiciformis.

DeGarengot, in 1731 was the first to describe the appendix as a content of a hernial sac. The next case was reported by Amyand in 1736, and another by Morgagni in 1761, and in 1785 Hevin described in detail an operation for purulent appendicitis in the sac of a femoral hernia. Other cases were reported by Tuitsehler in 1806, Hesselbach in 1814, Taramelli in 1835, Javanelli, in 1836 and a number of other early writers.

Merling, in 1836, described a strangulated appendical hernia that was successfully operated on by Tiedmann. Charvau, in 1837, and Cibrac, in 1842, also reported instances in which they had operated for hernia of the appendix. During this early period, operation was undertaken only when an abscess had formed, and then the procedure consisted of simple incision and drainage.

From the middle of the nineteenth century the operation was resorted to with increasing frequency, and with the advent of antiseptics it was undertaken earlier, but unless the appendix was gangrenous, it was reduced into the abdominal cavity. It was not until near the close of the last century that the removal of the appendix became a routine procedure.

Vargas, in 1929, wrote on tuberculosis of the appendix in the hernial sac and reported 3 cases. Biolato, in 1934, dealt with the pathology. Heard, in 1935, discussed appendicitis operations as a cause of right inguinal hernia. Oomen, in 1936, found an acute appendicitis in a left inguinal hernia sac. Lucchese,

in 1936, made an exhaustive study of the etiology and pathology of hernial appendicitis, and Salarich collected the reported cases of gangrene of the appendix in the hernial sac. Jorge Morchio and Nudelman in 1937, summarized the symptoms of the cases in which part of the cecum also occupies the sac. Ryan, in 1937, published an excellent review of the subject. Wakeley, in 1938, reported 16 personal cases of hernia of the appendix. Wulff, in 1940, recorded 3 cases of femoral hernia of the appendix. McCarty, in 1941, Seley, in 1941, Zuckermann in 1942, and Black and Waugh in 1942 wrote on hernial appendicitis. Natale, in 1943 dwelt on the obscure symptoms of the condition. Newerla and Connally, in 1943, prepared an exceptionally complete review of the cases reported in the literature. In 1944 de Lio and Sacerdoti reported a rare case of traumatic injury to an appendix in a hernial sac, a similar case having been recorded by Nedelkos and Anagnostidis. Loubetjae, in 1944, saw an interstitial postoperative appendix near hernia that required two operations to locate the second site the site of the strangulation. The same year Sylvestre Begnis published an admirable review of the etiology and diagnosis of hernial appendicitis and Knapp and Claps commented on a case of femoral hernia in which the appendix had been incarcerated for a year. In 1945 Loranger reported the case of an infant two and one half weeks old with hernial appendicitis and Vineberg wrote on the operative technique. Reggi in 1945 wrote on strangulated hernial appendicitis and its treatment. Newton in 1945 reported an unusual complication of rupture of the artery of the appendix in a femoral hernia sac. Carvalho Pinto, in 1945, published an excellent and extensive review on hernia of the appendix. Trick, in 1946 recorded 7 cases of strangulated hernial appendicitis. Kersechner, in 1947, reported the case of an infant eight days old with hernial appendicitis. Farr in 1947 recorded the case of a child in which the appendix was firmly held in the hernial sac by a pin the pinhead being in the lumen of the appendix.

### STATISTICS

In 1946 I collected from the literature 924 cases of hernia of the appendix. Of these 599 were inguinal, 292 femoral, 2 obturator, and in 33 the site of the hernia was not stated.

#### Inguinal Hernia of the Appendix

Age—In 591 cases the age of the patient was given as follows:

YEARS	CASES
10 or less	50
11 to 20	31
21 to 30	75
31 to 40	30
41 to 50	63
51 to 60	84
61 to 70	46
71 to 80	18
81 to 90	4
	591

**Duration of the Hernia**—The duration of the hernia was given in 170 cases

DURATION	CASES
41 to 50 years	4
31 to 40 years	4
21 to 30 years	9
11 to 20 years	20
1 to 10 years	48
1 to 11 months	13
Less than 1 month	6
Less than 1 day	4
Congenital	62
	170

**Sex**—The sex was given in 436 cases 392 were males and 44 were females

**Side Involved**—The side involved was stated in 478 cases 439 on the right side, and 39 on the left side

**Duration of Acute Symptoms**—The duration of acute symptoms before operation, or before abscess formation or before time of death in nonoperative cases are given as follows

DURATION	CASES
1 to 4 weeks	20
6 days	3
5 days	7
4 days	12
3 days	18
2 days	21
1 day	25
12 hours	18

In 84 cases it was stated that the appendix was entirely in the sac In 13 cases the hernia of the appendix was found at autopsy In 14 cases the appendix was adherent to the testicle, and in 3 cases it was adherent to the cord In 2 cases the appendix was cystic, and in 7 patients the condition was diagnosed before operation

**Length of Appendix**—The length of the appendix was given in 64 cases the average length was 3 inches (7.5 cm) in 19 the appendix was 4 inches (10 cm) or longer

**Treatment**—

	NO CASES	RECOVERIES	DEATHS
Appendix excised	324	207	18
Appendix reduced	17	15	2
Appendix operation	38	37	1
Abscess drained	30	20	10

Of the patients treated by taxis, 2 died of peritonitis In 2 the hernia was reduced en masse, one of these patients was operated upon and recovered, and the other one developed peritonitis, and a fecal fistula formed

### Inguinal Hernia of the Appendix in Infants and Children

Inguinal hernia of the appendix is not rare in infants and children, contrary to the statements in some of the papers published on the subject. The authors no doubt failed to make a thorough survey of the literature. In 1946, I collected from the literature 280 cases in infants and children ten years of age and under. There were 162 cases in patients under two years of age, as shown in the accompanying table.

AGE	Newly born	1 day	3 days	1 week	2 wk	3 wk	4 wk	5 wk	6 wk
NO CASES	1	1	1	11	8	5	5	2	6

AGE	7 wk	9 wk	10 wk	12 wk	15 wk	4 mo	5 mo	6 mo	7 mo
NO CASES	2	11	2	8	2	8	5	4	5

AGE	8 mo	9 mo	10 mo	11 mo	12 mo	13 mo	14 mo	15 mo	16 mo
NO CASES	4	1	3	2	21	2	3	6	7

AGE	17 mo	18 mo	19 mo	20 mo	21 mo	22 mo	23 mo	2 yr	3 yr
NO CASES	1	1	1	3	2	3	0	10	1

AGE	4 yr	5 yr	6 yr	7 yr	8 yr	9 yr	10 yr	7 wk 10 yr
NO CASES	11	10	5	6	13	4	3	10

### Appendicectomy as a Cause of Inguinal Hernia

I have seen 200 patients who developed inguinal hernia after an operation for appendicitis. In 172 the sex was given, in 166 the side was designated, in 196 the age was noted, in 194 the time of appearance of the hernia after the appendix operation was stated, as shown in the following paragraphs.

**Sex**—The sex was given in 172 cases. There were 162 males and 10 females.

**Side Involved**—The side involved was stated in 166 cases.

Right	116
Left	35
Bilateral	15
	166

**Age**—The age was known in 196 cases.

	YEARS						
AGE	10-19	20-29	30-39	40-49	50-59	60-69	70-79
NO CASES	1	32	53	43	43	16	3

**Onset of Inguinal Hernia**—The time of the appearance of the hernia following an appendix operation was known in 198 cases.

	YEARS																			
AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
NO CASES	10	11	11	9	9	5	12	2	6	14	44	18	26	10	2					

**Femoral Hernia of the Appendix**

**Age**—In 250 of the 292 cases of femoral hernia of the appendix alone, the age of the patient was given

YEARS	CASES
Under 2	0
2 to 5	5
11 to 20	1
21 to 30	10
31 to 40	24
41 to 50	58
51 to 60	46
61 to 70	65
71 to 80	27
81 to 90	5
Adult	9

**Duration of the Hernia**—The duration of the hernia was given in 79 cases

DURATION	CASES
41 to 50 years	1
31 to 40 years	1
21 to 30 years	6
11 to 20 years	13
6 to 10 years	11
1 to 5 years	31
1 to 11 months	5
1 to 2 weeks	3
1 day	2
Less than 1 day	3
Congenital	3
	79

**Sex**—In 249 cases the sex was given 223 females and 26 males

**Side Involved**—In 232 cases the location of the hernia was stated 211 were on the right, and 21 on the left side

**Duration of Acute Symptoms**—The duration of acute symptoms of appendicitis was given in 145 cases

DURATION	CASES
6 months	1
5 months	1
7 weeks	1
3 to 4 weeks	6
1 to 2 weeks	26
6 days	2
5 days	11
4 days	11
3 days	20
2 days	22
1 day	20
12 hours	11
Less than 12 hours	12
	145

**Simultaneous Appearance of Hernia and Appendicitis**—In 16 cases the symptoms of appendicitis were present when the hernia first appeared. The symptoms had been present

	CASES
6 months	1
2 weeks	4
9 days	2
8 days	2
5 days	2
3 days	3
2 days	1
1 day	1
	<hr/> 16

In 33 cases the entire appendix was in the sac. In 3 cases the femoral hernia of the appendix was discovered at autopsy. In 3 cases the appendiceal hernia was diagnosed before operation. In 2 cases there was retrograde strangulation of the appendix. In one a hernial abscess was due to perforation of the appendix by a pin.

**Length of the Appendix**—The length of the appendix was given in 45 cases and the average length of the portion in the sac was 3 inches (7.5 cm). In two cases the appendix was 12 inches (30 cm) long.

**Treatment**—The method of treatment employed and the result was stated in 308 cases.

	NO CASES	RECOVERIES	DEATHS
Appendix everted	19	191	6
Appendix reduced	23	21	2
Abscess drained, fecal fistula	4	13	11

In one patient who recovered without operation a portion of the appendix 3 $\frac{1}{4}$  inches (8 cm) long was cast off by the bowel.

**Adhesions in Sac**—Hernial appendicitis is no longer a rare condition but is rather a complication to be expected in about 1 per cent of irreducible hernias. Hernia of the noninflamed appendix is much more frequent than statistics indicate. The hernial sac contents either reduces spontaneously or is replaced by the surgeon before he opens the sac. Furthermore the fact that the number of femoral hernias reported in the literature are only slightly less than the inguinal variety is proof that only those appendices that become adherent to the sac wall have a chance of being recorded. With the internal inguinal ring much larger than the femoral opening and in closer proximity to the appendix, it is reasonable to presume that the normal appendix is in an inguinal hernial sac much more frequently than the literature would lead us to believe.

### Anatomy

The appendix may be alone in the hernial sac or it may accompany the cecum or other viscera into the sac. A number of cases of congenital inguinal hernia are on record in which the appendix was found adherent, usually

at its tip, to the testis. The appendix may enter any of the hernial openings and for anatomic reasons it is nearly always found on the right side (Fig 241). Left sided hernia of the appendix is very rare. Sometimes the appendix remains in the sac for a long time without causing symptoms especially if it is associated with other viscera as in the case reported by Fernandez de Castro.

Diagnosis is seldom made before operation, the condition usually being discovered during an operation for hernia. Appendicitis in the hernial sac is almost always mistaken for strangulated omental hernia accompanied by appendicitis. When the appendix is the sole content of the sac the hernia is usually small and gives no symptoms until the appendix becomes inflamed and adherent to the sac wall. In reducible hernia appendiceal hernia is seldom diagnosed because the operator nearly always reduces the contents into the abdomen before the sac is opened.

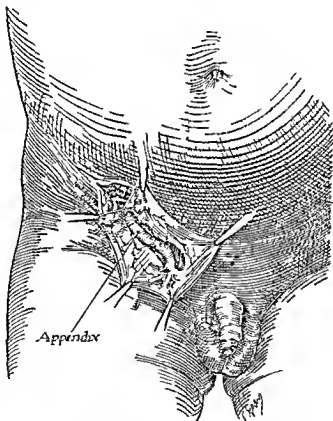


Fig 241—Inguinal hernia of the isolated appendix. Note the adhesions between the tip of the appendix and the fundus of the sac.

**Frequency**—A review of the literature shows that the appendix is present in 1 to 15 per cent of all hernias containing abdominal viscera. It is found in about 1 per cent of hernias in subjects between thirty and fifty years of age and in about 15 per cent of those past fifty. The appendix is nearly always accompanied by the cecum. Hernia of the isolated appendix is comparatively rare occurring about 3 times in 1 000 hernias.



In 3,000 autopsies at the Massachusetts General Hospital, Magruder found the appendix alone in a hernial sac 4 times

Gault and Baylis in a series of 230 femoral hernia operations found the appendix in the sac twice

Pales and Sohier stated that hernial appendicitis is very frequent among the Negroes of French Equatorial Africa. In 90 operations for appendicitis the appendix was in a hernial sac in 10 cases, 11 per cent

## VARIETIES OF HERNIA OF THE APPENDIX

The varieties of hernia of the appendix in the order of their frequency are inguinal, femoral, umbilical, diaphragmatic, ventral, obturator, perineal, and sciatic. It is possible for the appendix to make its exit through other openings but such instances have never been reported

**1 Inguinal**—Inguinal hernia of the appendix is by far the most common form, about 55 per cent of the recorded cases being of this variety. This is due to the proximity of the appendix to the internal inguinal ring, and to the fact that the inguinal ring is many times larger than the femoral ring

**2 Femoral**—The femoral variety constitutes about 40 per cent of all cases, being much less frequent than the inguinal variety. The femoral ring is situated only a short distance below the internal inguinal ring. Appendiceal femoral hernia would be more common than the inguinal variety because of the lower position of the femoral ring and the tendency of the cecum and appendix to gravitate downward, were it not for the fact that the femoral opening is not so constant as the inguinal opening, and when it does exist it is very much smaller than the inguinal ring. Because appendicitis of the isolated appendix is more frequent in femoral than in inguinal hernia, some writers have maintained that femoral hernia of the appendix is the more frequent variety. Statistics do not support this claim. Femoral hernia of the appendix nearly always occurs in women (98 per cent), it is very rare in men (2 per cent)

**3 Umbilical**—Umbilical hernia of the appendix is rare, constituting only about 4 per cent of all appendiceal hernias. The appendix has never been found alone in an umbilical hernia. In the few recorded cases it has been accompanied by other viscera, such as cecum, colon, omentum, and small intestine

**4 Ventral**—Ventral hernia of the appendix is very rare. It has been found in small hernias in the appendix region. In massive eventrations, involving most of the abdominal viscera, the appendix accompanies the cecum

**5 Diaphragmatic**—Diaphragmatic hernia of the appendix is always accompanied by other viscera, such as cecum, transverse colon, stomach, small intestine, and omentum. (See chapter on diaphragmatic hernia)

**6 Obturator**—Obturator hernia of the isolated appendix is very rare. In 924 hernias of the appendix which I collected from the literature, there were only 2 cases of isolated appendiceal obturator hernia (0.4 per cent)

## Pathology of the Appendix

The earliest recorded cases of appendiceal hernia were found at autopsy, or discovered after the incision of a hernial abscess, or during operation for

strangulated hernia. It should be borne in mind that the herniated appendix is liable to all the lesions of the intraabdominal appendix.

**Appendix Vessels**—The single artery supplying the appendix and its accompanying veins are subject to pressure from traction or kinking of the appendix. After infection occurs, the vessels are frequently obstructed by septic thrombi. In women a second artery is sometimes found in the peritoneal fold joining the broad ligament and appendix.

**Noninflamed Appendix**—The noninflamed appendix in a hernial sac is seldom diagnosed before operation. When the appendix is accompanied by the cecum or other viscera, it is usually healthy or only slightly diseased, because the hernial rings are necessarily large and the presence of the other viscera protects the appendix from pressure from the hernial ring, and adhesions to the sac wall do not form so often or so early as in isolated appendiceal hernia.

When the appendix is alone in the sac the hernial ring is small and constriction sometimes occurs. In 95 per cent of the cases of hernia of the isolated appendix, the appendix is adherent to the sac wall. Adhesions are more constant in this variety of hernia than in any other. The presence of adhesions and a narrow ring favor the early development of inflammation and infection. These complications are more frequent in femoral hernia on account of the small femoral ring and the pressure and trauma produced by the movement of the thigh, than in inguinal hernia. Appendices in hernial sacs may be of normal length, 4 to 5 inches (10 to 12.5 cm) but more often they are thickened and elongated, sometimes attaining a length of 5 to 12 inches (20 to 30 cm).

If there are other viscera in the sac the appendix is usually adherent to them as well as to the sac wall. The appendix may be curled or kinked on itself. When there is obstruction in the lumen near the base of the appendix, the distal portion may be the site of cystic distention due to an accumulation of the secretion from Lieberkuhn's follicles. Hutchinson stated that when the cystic appendix is intraabdominal, it may attain a diameter of 4 inches (10 cm) or more, and may closely resemble small intestine or a Meckel's diverticulum. It may contain several ounces of mucoid fluid.

When hernia of the isolated appendix occurs in subjects with enlarged hernial rings and relaxed abdominal walls it usually drags the cecum into the sac in a short time.

**Appendicitis in the Hernial Sac**—When the appendix is in the hernial sac, it is more commonly subject to acute and chronic inflammation than when it remains in the abdomen.

**Strangulation and Inflammation**—Strangulated appendiceal hernia is very rare. The term is often incorrectly applied to ordinary hernial appendicitis, and this has led to much confusion. Appendicitis in the hernial sac has often been diagnosed as strangulated hernia, simply because the mass was irreducible and gangrenous, while in reality the same changes in an intraabdominal appendix would have been ascribed to inflammation and infection. I believe that most of the reported cases of "strangulation" of the appendix are in reality hernial appendicitis.

Cunha has made a special study of the gastrointestinal symptoms accompanying hernial appendicitis.

Partial strangulation which is very frequently the first stage of hernial appendicitis is favored by the following factors: the dependent position of the appendix; the obstruction to the blood supply of the appendix due to the weight of the cecum or other overlying viscera; the occasional pressure exerted by the edge of the hernial ring; and rarely the presence of a fecal concretion or foreign body in the lumen of the appendix. The swelling, edema and congestion of the first stage together with the increasing circulatory obstruction lower the resistance of the appendix and provide the setting for the second stage which consists of infection followed by inflammation that terminates as a rule in gangrene and perforation.

FREQUENCY OF ABDOMINAL AND HERNIAL APPENDICITIS

	TOTAL CASES APPENDICITIS	NO. IN HERNIAL SAC	PER CENT
Donnenburg	4 000	8	0.2
Hofman	4 000	2	0.05
Fromme	690	1	0.14

**Strangulated Appendical Hernia**—When the cecum or other viscera are strangulated with the appendix the changes in the appendix seldom proceed beyond the first stage of edema and congestion. Complete strangulation of the appendix is rare and almost always occurs when the appendix is the sole content of the sac. Nearly all the recorded cases have been in femoral hernias. In strangulated appendical hernia the sac usually contains fluid which is clear, turbid or blood tinged. The appendix is dark in color, sometimes dusky or purple and if gangrenous it may have a dead leaf hue, the same as strangulated intestine.

**Tuberculous Hernia Sac and Appendicitis**—Tuberculosis involving the hernial sac is usually an extension of peritoneal tuberculosis and rarely it also includes the appendix. The condition is not as frequent as in former years. Imperati in 1938 made a thorough study of the etiology, symptoms and diagnosis and reported a case of appendicitis in a tuberculous hernial sac.

**Apoplexy of the Appendix**—The term apoplexy of the appendix was proposed by Pascal and Pillet to describe a partial strangulation of the appendix. The condition is characterized by an engorgement and thrombosis of the blood vessels and diffuse hemorrhages in the appendix and mesoappendix. Dallos observed a case in which the twisted appendix cut off completely the blood supply of the viscus.

**Point of Constriction in Strangulation**—The usual point of constriction is the rigid boundary of the hernial ring, especially the sharp edge of the lacunar ligament in femoral hernia. Sometimes the constriction is due to an omental band which is adherent to the sac wall or to the neck of the sac being very narrow or to a constriction in the sac itself.

**Mesoappendix**—When the mesoappendix accompanies the appendix into the hernial sac it soon becomes adherent to the sac wall or to the other contents. It is usually thickened, elongated and contains an excessive amount of fat which increases the danger of strangulation by pressure on the appendix.

When the mesoappendix is strangulated, it has the appearance of intense venous congestion, resembling strangulated omental hernia

Obstruction and incarceration are much more frequent in femoral appendical hernia than in the inguinal variety

**The Sac**—The sac of an appendical hernia may be complete, or it may be incomplete when some of its coverings are lacking. The appendix may be retroperitoneal, lying entirely outside of the sac, as in a sliding hernia of the large intestine. The sac may be single or multilocular. Harvey observed a case of hernial appendicitis in which the appendix constituted one side of the sac wall

#### Amount of Appendix in the Sac

**Complete**—The entire appendix is usually found in the sac of cecal hernias. Factors that favor the complete descent of the appendix are: an abnormally mobile cecum, a long mesoappendix, the absence of adhesions in the neck of the sac, and adhesion of the tip of the appendix to the testis, or to the fundus of the sac in complete hernia

**Incomplete**—In a majority of the cases of hernia of the isolated appendix only one half to two thirds of the appendix lies in the sac. Incomplete hernias are usually caused by adhesions of the appendix to the neck of the sac, a short mesoappendix, an immobile cecum and traction exerted on the appendix by the cecum. When the mobility of the cecum permits it to travel to the left side to a point opposite the left internal inguinal or femoral rings, it is an easy matter for the appendix to descend into a preformed sac. In left sided appendical hernias, the appendix is nearly always abnormally long, while in right sided ones, it is usually normal in length

**Localized Peritonitis**—Because of the isolated position of the inflamed appendix, extensive adhesions usually form early and confine the infection to the sac, thus preventing the peritonitis from invading the abdominal cavity. For this reason the prognosis in hernial appendicitis is more favorable than that in the abdominal variety

**Retrograde Strangulation**—Retrograde strangulation sometimes occurs, usually when the appendix is abnormally long. The central portion of the appendix is caught in the hernial ring, while the tip and the base remain in the abdomen. The pressure at two points obstructs the blood supply, and gangrene and perforation of the proximal end may develop rapidly

#### Etiology

Appendical hernias are most conveniently considered by dividing them into two groups, congenital and acquired

**1 Congenital**—Congenital hernias of the appendix are those in which the appendix is in the hernial sac at birth. The cecum usually has a long mesentery, it is freely movable and almost always accompanies the appendix into the sac. It is probable that isolated appendical hernia descends into a preformed sac, as other intestinal hernias do, or that it is drawn into it by the cecum, or a lax

mesoecum favors the development of a mesocolon thus increasing the range of movement of the cecum and appendix.

**2 Acquired**—Acquired hernias of the appendix are those in which the appendix enters a preformed or congenital sac after birth.

**Exciting Causes**—The exciting causes of appendical hernia are the same as those that apply to other intestinal hernias such as tumor strain lifting coughing whooping cough and anything that increases intraabdominal tension. When the cecum enters the sac first the hernia of the appendix is usually due to a long continued intraabdominal tension associated with a slipping of the parietal peritoneum such as occurs in sliding hernia.

**Predisposing Causes**—The predisposing causes of hernia of the appendix are abnormal mobility of the cecum elongation of the mesentery and sometimes of the appendix general ptosis of the abdominal viscera and relaxation of the abdominal wall and traction exerted on the appendix by the cecum or adherent viscera already in the sac.

**Age and Sex**—Isolated inguinal hernia of the appendix is found most frequently in subjects under ten years of age. Hernia of the appendix and cecum is found most often in the middle aged or elderly increasing in frequency as age advances. Femoral hernia of the appendix is most frequent between the fortieth and seventieth years. Inguinal hernia of the appendix nearly always occurs in males and femoral appendical hernia in females.

**Hernia of the Appendix in Infants**—Hernia of the appendix in infants and children is not a rare condition. In 160 of the reported cases the patients were under two years old and of 118 in children two to ten years old five were femoral. Bluel and Waugh's patient was under two weeks old. Forranger's patient was two and one half weeks old. O'Neill's patient was five weeks old and Buzger and Tarbitt's patient was only six weeks old. Halzel has written on the symptoms and diagnosis.

**Left Appendical Hernias**—Hernias of the appendix on the left side are very rare. When they are found in the newly born they are nearly always due to developmental anomalies and the cecum and ascending colon are usually found occupying the left side of the abdomen. In older subjects they may be accounted for by one or more of the following factors: ptosis of the cecum a mesentery so long that a large hernia containing ileum may by traction draw the cecum and appendix to the left side; scoliosis and liphosis. Transposition of viscera is rarely a cause of left sided appendical hernias in adults.

**Appendicitis in the Hernial Sac**—The same factors that are responsible for abdominal appendicitis are also the cause of hernial appendicitis. When the appendix enters the hernial sac it is subjected to more trauma and circulatory disturbances than when it remains in the abdomen consequently it often becomes inflamed its walls thicken and it becomes adherent to the sac wall or to other viscera. In inguinal hernia the exposed position of the appendix and the contractions of the abdominal muscles are responsible for considerable irritation and trauma to the appendix. In femoral hernia the narrowness of the hernial opening the pressure exerted by the sharp edge of the

lacunar ligament, and the trauma due to active movements of the thigh are responsible for the early development of appendicitis in a majority of femoral appendical hernias. The danger of strangulation of the isolated appendix is increased when the mesoappendix is thick and contains large lobules of fat.

### Symptoms

Hernias that contain only the appendix are small and easily reducible in the early stages, and cause few symptoms or none. Often they remain reduced most of the time, appearing only after some unusual strain or when the truss has been left off. Sometimes reduction of the hernia causes pain, and there may be a history of attacks of irreducibility and partial strangulation, accompanied by symptoms of appendicitis. In rare instances an appendical hernia will strangulate the first or second time it comes down. Hernia of the appendix is comparatively frequent in infants and children, and with these little patients it is sometimes possible to palpate the appendix in the sac. As a rule, the symptoms give rise to considerable pain and discomfort.

**Functional Symptoms.**—As long as the hernia is easily reducible or can be retained by a truss the patient is usually free from symptoms. As adhesions form between the appendix and the sac wall, he notices increasing pain and discomfort referred to the appendix region in the right hypogastrium, sometimes extending to the umbilicus or to the lower border of the ribs. Because of the small size of the hernia the symptoms are usually referred to the appendix and the possibility of a hernial appendicitis is generally overlooked. A correct diagnosis was made before operation in less than 1 per cent of the cases reported in the literature.

In acute hernial appendicitis, other symptoms in addition to pain are distention of the abdomen with some tenderness, but without rigidity of the abdominal muscles such as is found in abdominal appendicitis, malaise, fever, constipation, and disturbances in micturition. Flatus and feces continue to pass as obstruction does not occur unless small intestine, cecum or colon is strangulated by the hernial ring. Sometimes there is pain referred to the scrotum in inguinal appendicitis; in the femoral variety the pain may be referred to the hip joint and down the inner side of the thigh as far as the knee. Movement of the thigh on the affected side is limited and often accompanied by considerable pain. In rare instances there is a dragging pain referred to the right iliac fossa.

Both strangulation and inflammation are commonly ushered in with an acute onset. Nausea and vomiting may occur with both especially at the beginning. The abdominal pain is colicky, localized, or general. The symptoms are those of partial strangulation, and the condition is often diagnosed as a strangulated omental or Richter's hernia. When the appendix is strangulated, the temperature is subnormal and does not become elevated until after the onset of infection and inflammation.

In hernial appendicitis the temperature is not so high as in abdominal appendicitis, on account of the localization of the infection within the sac,

which is due to the early closure of the hernial opening by the inflammatory adhesions. Hence operation is usually delayed until after gangrene has developed. Shock and collapse are not marked except in children.

**Objective Signs**—The signs of a noninflamed appendix in the hernial sac are almost always vague and indefinite. In the beginning the hernia is small and easily reducible as adhesions form in the sac, it becomes tender and painful and more difficult to reduce. There is usually a history of occasional attacks of appendicitis with the local symptoms referred to the hernia, which is temporarily irreducible.

In many instances the hernia comes down for the first time during an acute attack of appendicitis and is immediately irreducible. If the appendix is alone in the sac and not adherent to the wall reduction is not accompanied by a gurgling sound and there is no impulse on coughing. When the cecum, colon or small intestine is also in the sac, the hernia is usually large, resonant on percussion and gives an impulse on coughing and when the hernial opening is small reduction is accompanied by a gurgling sound.

In children the appendix can sometimes be palpated in the hernial sac more often in inguinal than in femoral hernias, it feels like a thick round cord or a penholder. Sometimes it may be recognized by the elongated shape and hardness of the hernial mass. When the appendix is long and knotted or curled upon itself or when there is retrograde strangulation of the central portion it may feel like a double cord or be mistaken for a second testis.

The appendix in the hernial sac can hardly ever be felt in adults on account of the thick coverings of the hernia and the excess of fat in the meso-appendix that is often present in these subjects. Tension, inflammation or fluid in the sac may also interfere with the palpation of the appendix. When appendiceal hernias are exposed to considerable trauma as they are when located in the femoral region they become irreducible early because of inflammation and the formation of adhesions.

**Roentgen Ray Diagnosis**—When the symptoms are obscure and indefinite a roentgen ray examination will save much time in making a diagnosis and undertaking an early operation.

**Local Signs of Inflamed Appendiceal Hernia**—The local signs of inflamed appendiceal hernia are redness of the skin, edema, induration of the overlying coverings and gradual increase in the size of the tumor, tenderness and pain over the mass on pressure and dullness on percussion. The tumor is hard or fluctuating depending on whether or not an abscess has formed and there is no impulse on coughing. There is often referred pain and tenderness above the inguinal ligament but there is no rigidity of the muscles over the appendix region (McBurney's point) unless there is abdominal peritonitis. Picarra observed a patient with hernial appendicitis with all of the symptoms referred to McBurney's point.

These signs are absent in strangulation of the appendix when it is not accompanied by appendicitis and they do not appear until after infection takes place and inflammation develops.

### Complications

Strangulation, inflammation, irreducibility, and foreign bodies in the lumen of the appendix are the most frequent complications of appendical hernia. As already pointed out in anatomy, strangulation is the first stage and infection and inflammation the second stage of appendicitis in the hernial sac. It is usually impossible to determine when strangulation ends and inflammation begins or vice versa.

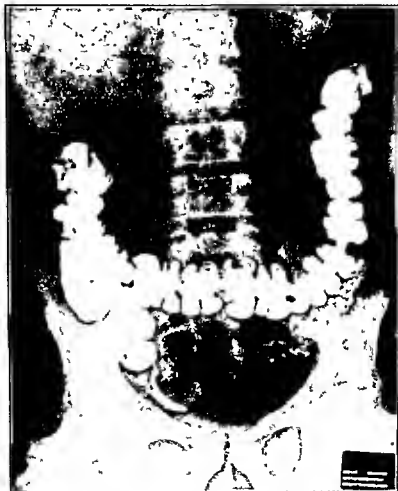


Fig 212.—Hernial appendicitis in a man forty five years old (Courtesy, Dr Felix Cunha.)

**Strangulated Hernia of the Appendix.**—When strangulated hernia of the appendix is incomplete and is not followed by inflammation, the symptoms are vague, often simulating those of strangulated omental hernia or a small Richter's hernia. There is an irreducible hernial mass that slowly increases in size with little or no pain and tenderness. Gastrointestinal and abdominal local symptoms are usually absent.

**Appendicitis in the Hernial Sac.**—Appendicitis in the hernial sac is often mistaken for strangulated hernia of the appendix. In the latter condition the



symptoms of appendicitis are absent. This error in diagnosis is perhaps due to the fact that operation is usually undertaken for a supposed strangulated enterocele or omentocele, and the most striking local symptom is irreducibility of the hernia, which usually is due to inflammation and not to constriction per se at the base of the appendix (Figs 242 and 243)

**Symptoms**—The symptoms of hernial appendicitis are similar to those of abdominal appendicitis, namely, nausea, vomiting, colicky abdominal pain, distention and constipation. There is no intestinal obstruction or rigidity of the abdominal muscles in the appendix region. When the appendix is in the sac alone, gangrene and perforation develop early, especially in femoral hernia.



Fig. 243—Hernial appendicitis in an adult with two small diverticuli of the appendix (Courtesy Dr. Felix Cunha)

**Irreducibility of the Noninflamed Appendix**—Irreducibility of a noninflamed appendix is nearly always due to adhesions of the appendix to the sac wall. Occasionally it is caused by cystic distention or kinking of the appendix, by adhesions to the cecum or to the peritoneum at the internal ring or by adhesions between the appendix and the testis in inguinal appendical hernias in males.

**Foreign Bodies in the Appendix**—Foreign bodies are occasionally found in the lumen or in the wall of appendices in hernial sacs. The substances most frequently found are spicules of bone, fruit seeds, bits of enamel, glass, short hairs, bristles, gallstones, intestinal parasites, such as tapeworms, thread worms, lumbricoids, trichocephalus bilharzi, and celnococci. Sharp-pointed objects often work toward the tip of the appendix, perforate its wall and cause inflammation or appendicitis. Langley found a nail in the lumen of an appendiceal hernia in a man, and I've found a broken blade of a hemostat beside the appendix in a hernial sac.

Kelloch found a pin imbedded transversely in the appendix and in the walls of the sac in an infant while operating for irreducible inguinal hernia. There had been no previous symptoms of inflammation or appendicitis in the hernia.

Collins (D. C.) observed an unusual case during World War II. The patient was an American soldier, nineteen years old, with a right inguinal scrotal hernia that contained the cecum, part of the ascending colon and terminal ileum along with the appendix. The appendix contained a black-headed pin 2 inches (5 cm.) long. The pin had perforated the tip of the appendix and the hernial sac and had worked its way through the testicle, the point of the pin finally perforated the posterior aspect of the scrotum. As a result, the patient was compelled to walk in an extreme bowlegged gait. I've discovered a pin in an inguinal hernia in a young child. The pin had perforated the appendix and imbedded itself into the sac, causing the hernia to become irreducible.

**Other Complications**—Other conditions that may complicate hernia of the appendix are benign and malignant growths in the appendix, spontaneous rupture of an appendiceal abscess with the formation of a fecal fistula, tuberculosis of the appendix, cyst of the appendix, and hydrocele of the hernial sac.

### Differential Diagnosis

The symptoms of hernia of the appendix so closely simulate those of other conditions that diagnosis before operation is often impossible. In children the appendix can sometimes be palpated in the hernial sac, but very seldom in adults. There is often a history of a small reducible tumor, and sometimes there have been previous attacks of appendicitis, when the mass became temporarily irreducible. When inflammation develops the tender, painful irreducible tumor gradually increases in size, accompanied by the general symptoms and local signs of appendicitis. When the inflamed appendix accompanies the cecum, colon, omentum, or small intestine into a large hernial sac, the only symptoms of appendicitis may be those of hernial peritonitis.

Appendiceal hernia may be mistaken for the following conditions:

- 1 **Omental Hernia**—An irreducible omental hernia presents a hard, irregular mass which is insensitive to pressure. Pressure or traction on the tumor does not cause pain referred to the appendix region. A strangulated omental hernia seldom has any signs of intestinal obstruction, and the symptoms of inflammation characteristic of appendicitis are usually lacking.

**2 Partial Enterocoele**—A partial strangulation or ‘nipping’ of the intestinal wall gives the symptoms of strangulated hernia without complete obstruction of the bowel. Vomiting and shock are more marked than in strangulated hernia of the appendix and the symptoms of appendicitis are lacking. In delayed cases however, it is usually impossible to make a diagnosis except at operation.

**3 Strangulation or Torsion of the Ovary and Tube**—Hernia of the ovary and tube is found most often in infants and children and occurs with nearly equal frequency on the right and left sides. There is almost always a history of an irreducible tumor present since birth. It is globular in shape, painful on pressure and moves with the uterus when the latter is palpated through the rectum or the vagina. Torsion of the tube occurs occasionally and as the symptoms are similar to those of strangulation diagnosis is seldom made except at time of operation. Several cases are reported in the literature in which the ovary and tube accompanied the appendix into a hernial sac.

**4 Adenitis**—Inflamed lymphatic glands especially in the femoral region may simulate a hernia of the appendix. The inflamed gland is usually movable and the examining fingers can be passed beneath it showing that it is outside the hernial sac. Frequently more than one gland is enlarged. In rare instances a large inflamed or abscessed gland in the femoral region conceals a strangulated hernia. Battle observed appendicitis in a femoral hernia associated with inflammation of the overlying lymphatic glands.

**5 Strangulated Epiploic Appendix**—Strangulation or torsion of an epiploic appendix must be distinguished from hernia of the appendix. Hernia of an epiploic appendix is most frequently found on the left side where it is attached to the sigmoid. The symptoms are not unlike those of omental hernia.

**6 Pus in the Hernial Sac**—Very rarely the pus from a gangrenous abdominal appendicitis gravitates downward into a congenital hernial sac. The inflammation at the neck of the sac causes the tumor to become irreducible. In the early stages the mass is fluctuating and accompanied by the symptoms of purulent abdominal appendicitis. This condition is to be borne in mind in examining ‘strangulated’ inguinal hernia.

**7 Disease of the Testis**—Disease of the testis must be thought of especially when the testis lies in the inguinal canal.

**8 Cyst of the Cord or Canal of Nuck**—A hydrocele of the cord or of the canal of Nuck is fixed in position or only slightly movable. The tumor does not vary in size and it is insensitive to pressure.

**9 Other Conditions**—Other affections that must be distinguished from hernia of the appendix are prehernial lipoma, torsion of the spermatic cord, intestinal diverticulum, supernumerary testis, reducible and irreducible hernias of the intestine, bladder and other viscera. Large or encysted appendices have been mistaken for the hernial sac or for a second sac. A long slender appendix must not be taken for the round ligament or spermatic cord.

**10 Meckel's Diverticulum**—A Meckel's diverticulum in an inguinal or femoral hernia can rarely be distinguished from an appendiceal hernia except at operation and even then mistakes are liable to be made. It is probable

that some of the cases of large appendices found in hernias especially on the left side are hernias of Meckel's diverticulum. If the appendix has a large lumen a thin wall and is abnormally long an attempt should always be made to identify the cecum so as to confirm the diagnosis. A Meckel's diverticulum has no mesentery while about 50 per cent of appendices in hernias have mesenteries.

Cases are on record in the literature in which fatal results have followed the mistaking of the inflamed appendix for the spermatic cord and leaving the appendix undisturbed in the sac while the other contents were reduced.

**11 Appendicitis and Hernia**—The coexistence of chronic appendicitis and hernia is not unusual. At times the pain and tenderness is ascribed to the hernia whereas the appendix is the chief offender. I have seen several cases of this type. Bachy and Rabourdin reported twenty seven cases of chronic appendicitis complicating hernia.

### Prognosis

Strangulation and inflammation occur more frequently in appendiceal hernias than when the appendix is intraabdominal. When the appendix is alone in the hernial sac it occupies an unprotected position and is subject to considerable trauma with the result that adhesions to the sac wall form early. In femoral hernia after adhesions have formed and the mass has become irreducible the irritation produced by the movements of the thigh and the constriction of the sharp edge of the lacunar ligament often lead to strangulation and hernial appendicitis.

Strangulation and inflammation are much more frequent in femoral hernia than in inguinal hernia. Gangrene and perforation occur earlier in femoral hernia than in inguinal hernia.

The mortality rate of appendicitis in the hernial sac is lower than that in abdominal appendicitis, because the process in the hernial sac usually becomes walled off early in the disease and the infection is localized within the sac. On account of the indefinite symptoms in inflamed hernia of the appendix the diagnosis is often delayed and operation is resorted to later than in abdominal appendicitis.

Whenever appendicitis in a hernial sac is suspected operation should be undertaken as soon as possible. The appendix should always be removed even when it is apparently healthy. A number of cases are recorded in the literature in which a hernia of the appendix was reduced into the abdomen and an operation for appendicitis was required later. In other instances when the hernia recurred the appendix entered the new sac and became inflamed.

Appendicitis in a hernial sac may be acute or chronic. The attacks have a tendency to occur more frequently and at shorter intervals than in abdominal appendicitis. However the acute form seldom runs as stormy a course in the hernial sac as it does in the abdomen and even when perforation occurs in the hernial sac the symptoms usually remain those of subacute appendicitis. I have collected from the literature 924 cases of hernia of the appendix in 145 there were symptoms of acute appendicitis.

### Treatment

**Truss**—The truss treatment of appendical hernia is never to be advised even when the hernia is reducible on account of the danger of the pressure and irritation causing an acute attack of appendicitis. In irreducible hernia the pressure of the pad on the appendix causes so much pain that the truss cannot be tolerated.

**Taxis**—Taxis must never be attempted in either strangulated or inflamed hernia of the appendix as there is danger of rupturing a nonperforated appendix or an unsuspected abscess and perhaps forcing pus into the abdomen which would probably cause a fatal peritonitis. There is also the possibility of reducing *en masse* a gangrenous intestine along the appendix.

### The Operation

**Noninflamed Appendix**—Operation is the treatment of choice for hernia of the appendix. The appendix should always be removed and never reduced into the abdominal cavity. If it cannot be removed through the hernial opening because only a part of it is in the sac and adhesions and immobility of the cecum prevent its base from being drawn down into view the incision should be extended upward through the inguinal ligament in femoral hernia and beyond the internal ring in inguinal hernia.

A better plan however is to make a second incision under local anesthesia in the lower abdomen and remove the appendix at the ceco-appendiceal junction after blocking the mesocolon (Fig. 244). This method permits a finer closure of the hernial opening than the first method which divides and weakens the internal ring favoring recurrence.

The appendix is crushed at its base with a forceps the latter removed and a ligature applied in the groove. The appendix is cut away and if haste is necessary the stump can be cauterized with phenol followed by alcohol and dropped back into the abdomen as advocated by Wyeth. The customary practice is to ligate, cauterize and invert the stump by means of a purse string suture.

Dissected omentum in the sac should be ligated and excised. In large hernias other viscera such as the cecum, colon and small intestine accompany the appendix and should be returned to the abdomen.

In dealing with appendiceal hernia complicated by extensive omental adhesions the operation is simplified if the omentum is first ligated and divided in small sections and then the sac removed with the end of the omentum still adherent to it. Subperitoneal fat may be mistaken for omentum if adhesions are very extensive or if there is inflammation or suppuration. If adhesions prevent the cecal attachment of the appendix from being brought down into the wound the base of the appendix can often be exposed by turning up a cuff of serosa and peeling the appendix out—the coat sleeve method.

**Appendicitis in the Hernial Sac**—When perforation has not taken place the appendix should be removed in the manner already described the hernia

repaired and the wound closed without drainage (The indications for the use of the inguinal and femoral incisions for irreducible femoral hernia are discussed in the chapter on femoral hernia)

If perforation or gangrene has developed or if an abscess has formed, the sac should be opened and any remaining portion of the appendix removed the wound drained and the hernia repaired at a later time In dealing with a gangrenous femoral hernia of the appendix Schräger stitched the sac to the skin and converted it into a drainage tube



Fig 744—Method of blocking the mesocecum in the operation for appendectomy under local anesthesia

If gangrene has extended beyond the tip of the appendix it is not safe to try to pull the appendix down to ligate it at the base A better plan is to make a second incision either a lateral rectus or a McBurney and draw the cecum and appendix up into the wound and complete the operation as for abdominal appendicitis When the appendix can be removed through the hernial opening, it is never advisable to anchor the stump to the neck of the sac it should be pushed back into the abdomen and covered with a piece of omentum if the latter is available Breglio uses a long skin incision for strangulated hernial appendicitis and a separate incision through the muscles and fascia

over McBurney's point to deal with the appendix Kipp also retracts the external oblique muscle and fascia upward and removes the appendix by a separate incision

**Retrograde Strangulation**—In retrograde strangulation only the central portion of the appendix is in the sac The tip lies in the abdomen internal to the constricting ring, and it is nearly always gangrenous and often is perforated, because the constriction obstructs its blood supply at two points The ring should be enlarged and the tip exposed and removed with as little dissection as possible to avoid spreading the infection (Fig 4)

**Fecal Fistula in a Hernial Sac**—When an appendiceal abscess is drained by incision or ruptures spontaneously, a fecal fistula often follows The intestinal opening will close of its own accord in a few weeks, provided all the appendix has been destroyed If the fistula persists, it is necessary to open the wound, remove the remainder of the appendix, and allow the wound to heal before attempting to repair the hernia

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## CHAPTER XXXII

### HERNIA OF MECKEL'S DIVERTICULUM

**Synonyms**—Littre's hernia, hernia of the appendix ilei

**Definition**—A hernia of Meckel's diverticulum is a protrusion of a diverticulum of the ileum through a hernial opening

(Meckel's diverticulum in umbilical hernia is not dealt with in this chapter, as the subject is discussed in the chapter on umbilical hernia)

#### Historical

The possibility of a diverticulum of the ileum appearing in a hernia was suggested by Ruysch, in his report of an autopsy in 1683. Littre, in 1700, reported two cases and described the diverticulum as a secondary formation arising from the intestine opposite the hernial ring. Wery, in 1701, reported a case, and Walther, in 1778, dissected a Meckel's diverticulum found in an inguinal hernia. Richter, in 1785, regarded these diverticula simply as partial enteroceles, while Scarpa, in 1804, briefly alluded to them along with appendical hernias and partial enteroceles. Boyer, in 1822, and Malgaigne, in 1840, described them. Riecke, in 1841, was the first to suggest calling them Littre's hernias. Broca, in 1853, drew attention to the difficulty of distinguishing the symptoms of partial enterocoele and hernia of Meckel's diverticulum. Morgan, in 1885, discussed the anatomy, and Zatti, in 1891, wrote at length on the etiology of this type of hernia. Fowler, in 1902, reported the first case of sciatic hernia of a Meckel's diverticulum.

Interest in the subject was stimulated by the monograph of Forgue and Riche, in 1907. Pabst, in 1910, published an exhaustive review covering 122 reported cases of hernia of Meckel's diverticulum. Wellington, in 1913, found a number of additional cases. In 1923, I collected 159 cases from the literature. Brodnax, in 1924, recorded the second case of sciatic hernia of Meckel's diverticulum. Sweet, in 1930, reviewed the subject of femoral hernia of Meckel's diverticulum. In 1931, Frankau published an important paper on strangulated hernia and its association with Meckel's diverticulum. Donati wrote at length on diverticular femoral hernia. Christie discussed the complications found in infants and children, and Gomez wrote on the operative technique. Harkins, in 1933, wrote on intussusception of Meckel's diverticulum, and Gray, in 1934, stressed the pathology. Bettinelli, in 1935, discussed the rare types of hernia. Meyer May in the same year reviewed the reported cases. Brunetti, in 1936, interestingly narrated the historical aspects. Keelev, in 1937, found a Meckel's diverticulum in a ventral hernia, and Perrignon de Troyes and Du Bourgniet wrote on the subject of unusual site contents. In 1938, Goodman discussed at length the pathology, Weinstein collected the reported cases of femoral hernia of Meckel's diverticulum, and Quiri in 1938, also reviewed the literature on this type of hernia.

Strohl and McArthur, in 1939, discussed the treatment of strangulation of Meckel's diverticulum in femoral hernia. Gofin Moreno in 1941, wrote on the umbilical type of hernia. Marti and Cottet, in 1942, again emphasized the value of roentgen ray examination as an aid in diagnosis. Dujovich and Shraer, in 1943, stressed the frequency of strangulation in the femoral type. Bird, in 1943, published an excellent review of the cases reported in the literature, and Fishback, in 1944, wrote on the diagnosis at time of operation. Haber, in 1947, published an excellent study of bowel obstruction in these hernias.

Mason, in 1933, wrote most interestingly on the life of Littre and his first case of diverticular hernia. The symptoms and diagnosis as narrated by Littre are still a classic and have never been improved upon by modern writers.

### Statistics

**Age**—Hernia of Meckel's diverticulum is most frequently found in adults especially in middle aged persons. In 1946, I collected 259 cases from the literature. In 211 cases, including my own, the ages were given as follows:

AGES	CASES
50 minutes	1
21 days old	2
1 week old	1
1 to 10 years	20
10 to 20 years	13
20 to 30 years	17
30 to 40 years	21
40 to 50 years	27
50 to 60 years	24
60 to 70 years	16
Over 70 years	10
Age not given	50
	<hr/> 211

**Sex**—As in other affections of Meckel's diverticulum, hernia is most frequent in males, the proportion being 110 males (62.5 per cent) to 41 females (37.5 per cent).

**Side Affected**—In 143 of the 259 cases I collected, 109 were on the right and 34 on the left side.

**Site**—Hernia of Meckel's diverticulum usually occurs in the inguinal region. In the series which I studied, 135 hernias were inguinal, and of this number 96 were in males, 16 in females. In 94 the hernia was on the right side and in 30 it was on the left side.

Fifty four hernias were in the femoral region. Of these 28 were in females, 20 in males, and in 6 the sex was not given. The right side was most frequently affected, 30 of the hernias being on that side, with 6 on the left side, in 18 cases the side was not mentioned.

There were 32 umbilical hernias of which 9 were in males and 7 in females, in 16 the sex was not given. There was one ventral hernia in a man. Two hernias were in the sciatic region, in one patient, a woman aged forty seven years reported by Fowler, strangulation was followed by a fecal fistula, and the patient recovered, Brodnax found one at autopsy in a man aged nineteen years.

### Anatomy

There are two anatomic varieties of hernia of Meckel's diverticulum the noninflamed and the inflamed

**Simple Noninflamed Hernia of Meckel's Diverticulum.**—In simple hernia of Meckel's diverticulum the diverticulum may lie free in the sac as in the cases observed by Littic in 1700 and by Carin in 1862. However it is most often adherent to the sac wall.

Many writers have noted the intimate connection between the diverticulum and the testis or epididymis in inguinal hernias.

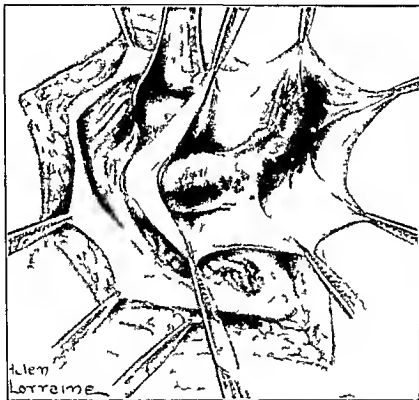


Fig. 245.—Meckel's diverticulum adherent in an inguinal hernia sac.

The diverticulum may be accompanied by small intestine which is sometimes strangulated or by omentum alone. Hunter found the sigmoid and ileum with the diverticulum. Brodnav found a Meckel's diverticulum 4 inches (10 cm) long in a scrotal hernia. In some cases the presence of the diverticulum at the neck of the sac prevented the reduction of the hernia by taxis. Strangulation of the isolated hernia of Meckel's diverticulum is more frequent in femoral than in inguinal hernia.

**Hernial Diverticulitis.**—Inflammation and strangulation of a hernia of Meckel's diverticulum have the same etiology and pathology as has hernial appendicitis (Fig. 245).

As with appendical hernia inflammation is much more frequent than strangulation. When so called strangulation occurs it is nearly always

simply secondary to the inflammation and infection. True strangulation of a Meckel's diverticulum is rare. Sometimes it is impossible to determine whether inflammation or strangulation occurs first.

**Embryology**—This condition is a developmental defect and is often associated with other malformations or anomalies. A Meckel's diverticulum results when the vitelline or omphalomesenteric duct, which connects with the yolk sac or umbilical receptacle, fails to shrink and atrophy. When this blind appendage persists, it may be 2 to 4 inches (5 to 10 cm) in length. It is almost always found within 3 feet (1 meter) from the ileocecal valve. The diverticulum is usually 2 to 4 inches (5 to 10 cm) in length, although in one case it was 28 inches long (70 cm).

**Frequency**—A Meckel's diverticulum in the abdominal cavity is present in about 1 per cent of individuals. Turner, in 10,300 necropsies, found 81 Meckel's diverticula or 0.8 per cent. Frankau, in 654 strangulated inguinal hernias, found a Meckel's diverticulum in the sac in 4 cases. Starlinger in 1,395 inguinal hernia operations found a Meckel's diverticulum in 16 cases, and in 229 femoral hernia operations found a diverticulum once.

### Etiology

Hernia of Meckel's diverticulum is rare. In 600 cases of Meckel's diverticulum collected in the literature by Fargue and Riche, there were only 52 instances of hernia. In the order of frequency the condition of the diverticulum was as follows: closed, open, inflamed, the state of benign adenomas, and the site of intestinal cysts.

**Age**—Hernia of Meckel's diverticulum is most frequently found in adults and in middle aged subjects.

**Sex**—As in other affections of Meckel's diverticulum, hernia is most frequent in males, the proportion being of 110 males (62.5 per cent) to 41 females (37.5 per cent).

**Side Affected**—In 13% of 259 cases I collected 104 were on the right and 34 on the left side.

**Site**—Hernia of Meckel's diverticulum usually occurs in the inguinal region. Femoral hernias are less frequent (see statistics).

**Predisposing and Active Causes**—The same predisposing and active causes that are described for hernia of the small intestine are also responsible for hernia of Meckel's diverticulum. The diverticulum lies free in the abdominal cavity until it enters the hernial sac.

### Symptoms and Diagnosis

Hernia of Meckel's diverticulum presents no special symptoms on which a diagnosis can be based, or the presence of a diverticulum even suspected. The symptoms are those common to appendical hernia, partial enterocele, and epiploitis in a hernial sac. Inflammation and adhesions to the sac wall often result in the tumor becoming partially or completely irreducible.

Simple hernia of Meckel's diverticulum is completely reducible if it is not adherent to the sac. Often a gurgling sound is heard when the diverticulum is

reduced When the hernia is incompletely reducible, due to the presence of adhesions, a hard fibrous cord is felt just above the testis after the greater portion of the hernia has been reduced In this respect it resembles a hernia of the appendix Lind states that when a nonstrangulated hernia causes abdominal distress, and at the same time is sensitive to pressure, one should bear in mind the possibility of Meckel's diverticulum adherent to the sac wall

**Strangulation**—The symptoms of strangulation of hernia of Meckel's diverticulum were first described by Littre They are similar to those of partial enterocele and hernia of the appendix The general symptoms are not severe, there is seldom vomiting, and obstruction is not complete There is a small tumor in the affected region, which slowly increases in size, and the local signs, pain, tenderness, tenseness and irreducibility are more marked than the general symptoms

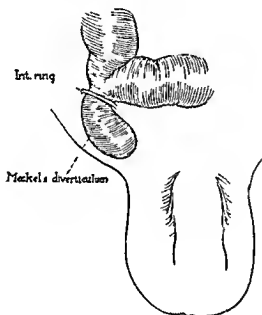


Fig 246—Schematic drawing of an inguinal hernia of Meckel's diverticulum.

**Diagnosis**—A Meckel's diverticulum should be suspected when the hernial contents apparently consist of a single loop of intestine, which seems to have a blind end, or which appears to terminate in a culdesac that is adherent to the sac wall A hernia of Meckel's diverticulum is larger than an appendiceal hernia, and the symptoms are usually less acute because of the larger lumen of the intestine When the sac is opened, the absence of a mesentery should cause the operator to think of a Meckel's diverticulum (Fig 246)

**Intestinal Hemorrhage**—Abdominal pain accompanied by intestinal hemorrhage or tarry stools should lead one to look for a hernia of a Meckel's diverticulum

**X ray Examination**—Marti and Cottet report a rare case of strangulation and perforation of a Meckel's diverticulum in a left femoral hernia They point out that when other methods fail, a diagnosis may be made before operation by a careful roentgen ray examination

### Prognosis

The prognosis for hernia of Meckel's diverticulum is more favorable than that for ordinary enteroceles because the intestinal tube is not obstructed and is only indirectly involved. The mildness of the local symptoms is often responsible for delayed treatment in strangulation. General peritonitis occurs more frequently as a complication than is ordinarily supposed. The indications for operative treatment are the same as those for other intestinal hernias.

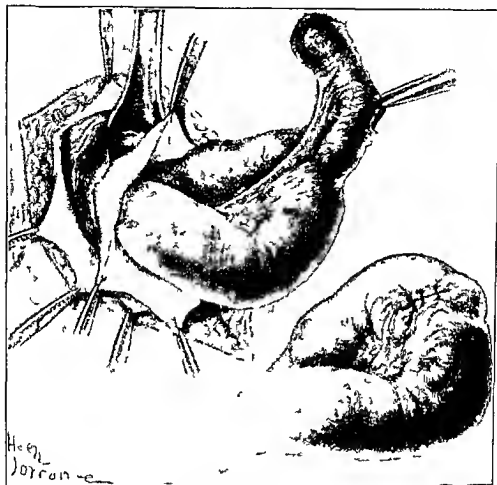


Fig. 247.—Operation for Meckel's diverticulum. Longitudinal excision of diverticulum with transverse closure of intestinal incision.

Should a fecal fistula occur there is danger of the patient dying of inanition on account of the opening being high up in the intestinal tract. The fistula may close spontaneously or it may remain open for a long time. It should always be closed by operation as soon as possible. Tedenat saw a case in which it remained open for six years and later an abscess developed at this point caused a general peritonitis and the patient died.

### Treatment

The radical operation with excision of the diverticulum is the treatment of choice for hernia of Meckel's diverticulum. If the diverticulum is reduced into the abdominal cavity, there is danger of subsequent attacks of diverticulitis.

Whether the diverticulum is alone in the hernial sac or with other viscera, it should be resected at the point where it joins the small intestine, and the opening closed by a careful intestinal suture. This suture line should be covered over with a piece of omentum, if it can be secured, to prevent postoperative adhesions. To lessen the danger of stenosis of the intestine, the excision of the diverticulum should be longitudinal, parallel with the lumen of the intestine. The closure of the incision should be with a transverse suture. This gives a maximum patency of the intestine at the point where the diverticulum was excised. A small diverticulum can be handled much like an appendicectomy.

The abdominal intestine should always be examined for some distance beyond the attachment of the diverticulum, for evidence for beginning necrosis or gangrene. A number of cases have been recorded in the literature in which perforation and peritonitis developed after the reduction of an apparently nongangrenous diverticulum. The treatment of strangulated hernia associated with a Meckel's diverticulum is the same as that for intestinal hernia alone (Fig 247).

In 124 of the 209 cases of hernia of Meckel's diverticulum which I collected from the literature, the termination of the disease was as follows:

	NO CASES	RECOVERIES	DEATHS
Diverticulum excised	106	95	7
Operation and drainage	7	5	2
Spontaneous fistula	5	3	2
Operation—diverticulum reduced into abdomen	6	4	2
	124	111	13

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## CHAPTER XXXIII

### HERNIA OF THE BLADDER

**Synonyms**—Vesical hernia, cystocele, cystic hernia

**Definition**—Hernia of the bladder is a protrusion of a part of the bladder through a normal or an abnormal opening in the abdomen or pelvis

It constitutes about 1 per cent of all hernias found in adults and is less frequent in children. Brunner collected the records of 1,841 cases of hernia and found bladder hernia in 1 per cent, in 2,543 consecutive hernia operations gathered by Moynihan, there were 23 cases of bladder hernia. Lucas Championnière found 6 in 900 operations. Carl found 13 in 1,400 operations, while Eggenberger found it 75 times in 6,778 operations. In 6,776 cases of inguinal and femoral hernias reported by Coley and Hognet there were 17 hernias of the bladder, 10 of these were in children under fourteen years of age, and 7 in adults between twenty five and seventy five years of age.

#### Historical

The first case of bladder hernia was recorded by Plater, of Basle, in 1550, and the second case by Salvi, of Venice, in 1620. Ruyseh recorded a case in 1691, and Duvoux, in 1732, reported one and collected several cases in the literature. The first attempt at surgical treatment was made in 1740 by Arnand, who incised the bladder and tamponed the wound. In 1744 Gunz wrote on this subject, ten years later C. Verdier published an important paper embracing a study of 20 cases including a case of his own of femoral hernia of the bladder, the first one to be reported. He called attention to prevesical lipoma as a possible cause of bladder hernia and described the symptoms of vesical hernia much as we know them today.

Following C. Verdier's paper, hernia of the bladder received scant attention, although it was sometimes seen during the course of an operation for strangulated hernia or at autopsy, until 1808 when Cooper described 2 cases in living subjects and 2 others discovered at autopsy. He was the first to suggest inflating the bladder in the hernia, as a means of diagnosis. In 1840 Verdier the second, wrote a paper on the pathology of bladder hernia, and in 1847 Nelaton emphasized the importance of chronic distention of the bladder as a predisposing cause. Monod and Delagènière in 1889 wrote on the subject of lipoma as a cause of bladder hernia.

Up until the beginning of the present century the belief was prevalent that the primary suturing of bladder wounds was liable to invite urinary infiltration, fistula, or peritonitis. For this reason, many of the older surgeons sutured the edges of the bladder wound to the skin, if the patient survived, the fistula was closed at a second operation.

With the introduction of antiseptic surgery, bladder wounds in the course of hernia repair were no longer a serious complication, provided the bladder incision was properly sutured.

In 1923, I collected 305 cases from the literature. Boietti, in 1928, published his monograph on bladder diverticuli. Wakeley, in 1930, reported forty cases of hernia of the bladder. He believes that bladder hernia is present in 1 to 3 per cent of all direct inguinal hernias. Rolmetti, in 1931, wrote on the etiology of bladder hernia. Samuels, in 1931, narrated his observations on the condition. Leo, in 1932, studied 75 cases of femoral hernia of the bladder. In 1933, Makkas discussed the problem of massive bladder hernia, Vastola dealt with the diagnostic symptoms, and Lazzarini reviewed the literature. Neumann, in 1934, published a paper on strangulation of a bladder diverticulum in hernia. In 1935, Bierhoff and Unger emphasized the value of cystography as a diagnostic aid, White reported a rare case of interstitial hernia of the bladder through a slit in the conjoint tendon, and Petrone and Vieira published a paper on strangulation of the bladder in a hernia. In 1936, Bernabeo discussed the pathology of bladder hernia, and Campellone reviewed the literature. Teopaca, in 1937, reported cases of bladder hernia. Podio, in 1939, wrote on bladder hernia in women. Wakeley, in 1939, recorded 75 bladder hernias in the course of 5,000 hernia operations. Lang in 1940, published an article on sliding hernia of the bladder. Levy, in 1941, reviewed the literature on bladder hernia. Pacheco Diaz, in 1943, discussed femoral hernia of the bladder.

### Statistics

In 1946, I collected from the literature 527 cases of hernia of the bladder, including my own cases.

**Sex**—In 397 cases the sex was given as follows: males 276, and females 121.

**Site and Side**—In 436 cases of inguinal and femoral hernia, the site and side were as follows:

INGUINAL				FEMORAL			
R	L	BILATERAL	SIDE NOT GIVEN	R	L	BILATERAL	SIDE NOT GIVEN
154	112	7	62	53	24	4	20

Other varieties were as follows:

Perineal	2
Sciatic	2
Ventral	5
Obturator	1

**Relation of the Sac to the Peritoneum**—The relation of the bladder to the peritoneum in 386 cases was as follows:

Paraperitoneal	231
Extraperitoneal	120
Intraperitoneal	35

**Diagnosis of the Bladder Hernia**—In 363 cases the time of diagnosis of the bladder hernia was as follows

Before operation	27
During operation	293
After operation	43

**Injury to the Bladder.**—In the 527 cases of vesical hernia that I collected from the literature, the bladder was wounded during operation in 201 cases

**Mortality in Cases of Injury**—In 151 cases the result was given as follows

TIME OF DISCOVERY OF INJURY OR OF DEATH	RECOVERED	DIED
12 hours	2	1
1 day	3	2
2 days	0	2
3 days	1	6
5 days	2	3
8 days		1
Time not stated	118	10
	<hr/> 126	<hr/> 25

Mortality rate following discovery of injury after operation was as follows

TIME OF DISCOVERY OF INJURY	RECOVERED	DIED
12 hours	1	1
24 hours		1
2 days		4
3 days		2
4 days		1
5 days		2
Time not stated	19	0

**Duration of Fistula**—In 31 cases the duration of the fistula after the injury was given as follows

1 day	10
5 days	2
7 days	1
2 weeks	1
4 weeks	5
6 weeks	1
8 weeks	7
Few weeks	3
Year or more	5

## Anatomy

The bladder may make its exit through any of the normal hernial openings in the lower part of the abdomen or the pelvis, or it may come through at an abnormal point. It usually appears in the opening that is nearest to it.

**Varieties**—The usual varieties of bladder hernia are inguinal, femoral, perineal, obturator, sciatic, and linea alba.

**1 Inguinal.**—Inguinal bladder hernia is by far the most common variety and usually occurs in men. It is more frequent on the right side. Extra peritoneal hernia in the inguinal region is usually direct if only the bladder is involved.

**2 Femoral.**—Femoral bladder hernia is much less frequent than inguinal. I found 100 cases of femoral hernia and 336 of the inguinal variety. Femoral

hernia of the bladder almost always occurs in women and is most often on the right side bilateral femoral hernia is very rare

3 Perineal—Bladder hernia through the perineum may be either anterior or posterior perineal and it most frequently occurs in women although a few cases have been observed in men Harrington saw a case in a woman which was complicated by a large filarial tumor

4 Obturator—Obturator hernia of the bladder is infrequent only a few cases have been reported

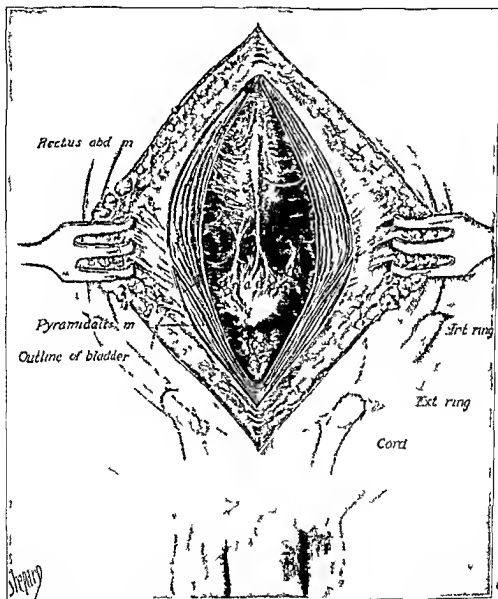


Fig. 248.—The relation of the bladder to the inguinal canal and rings. The normal position of the bladder is in the pelvic arch at the pubes and its relation to the hernial rings depends on the age and sex of the subject.

5 **Sciatic**—Sciatic hernia of the bladder is very rare. An unusual case has been reported by Sehreger, and another one by Burn.

6 **Linea Alba**—Bladder hernia through the linea alba is infrequent and most often occurs in women. It may make its exit at any point in the lower third of the linea alba.

Bilateral inguinal hernia is very rare. I collected 7 cases from the literature.

**Pathology of the Bladder**—The normal position of the bladder is in the pelvis behind the pubes. It is situated in front of the rectum in the male, and in front of the cervix uteri and vagina in the female. The relation of the bladder to the hernial rings depends upon the age and sex of the subject, and the degree of distention present. A bladder must be abnormally large before a part of it can be forced into the hernial opening, or its attachments must be relaxed or a diverticulum must exist. (Fig. 248.)

**Hernial Sac**—The bladder may be outside the peritoneum, or it may be partially or wholly covered by it. In this respect, it differs from an enterocele which almost always has a true hernial sac. As first proposed by Jaboulay and Villard, bladder hernia is divided into three varieties, this classification depending on relation of the peritoneum to the herniated bladder: extraperitoneal, intraperitoneal and paraperitoneal. Primary vesical hernias may be extraperitoneal or paraperitoneal, while the secondary bladder hernias are either intraperitoneal or paraperitoneal.

1 **Extraperitoneal Hernia** (cystocele without serous sac—Duret)—While extraperitoneal cystocele is the rarest of the three varieties, it is probably more frequent than the number of reported cases indicate, because it produces no symptoms as long as the hernia remains small. It is always direct in the inguinal region, and, as a rule, it is very small, although one the size of an orange has been reported. Moynihan remarks that a careful study has shown that many so called "extraperitoneal hernias" have a small diverticulum whose outer wall of peritoneum is the inner covering of the sac, and, in reality, they are paraperitoneal hernias. Because extraperitoneal hernia lies entirely outside the sac, it is most liable to injury by being opened through mistake for the sac itself, especially if the operator has lost his landmarks and searches for the sac internal to the deep epigastric artery.

In inguinal hernia the anterior or lateral surface of the bladder, which is extraperitoneal, enters the canal first. The peritoneum entirely covers the superior surface of the bladder and is adherent to the lateral wall above and behind. (Figs. 249A and 249B.) As a rule, when there is a large amount of prevesical fat, the peritoneum is easily stripped off the bladder. Ane reported a femoral extraperitoneal hernia, and Gladstone saw an obturator extraperitoneal hernia.

2 **Paraperitoneal Hernia** (enterocystocele, with incomplete serous sac—Duret)—Paraperitoneal hernia is the most common of the three varieties. It has a sac, and may be direct or indirect. The bladder is on the inner side of the sac, and the peritoneum of the inner wall of the sac is the serous covering of the outer portion of the bladder, the remainder of the bladder out-

Fig 249A.

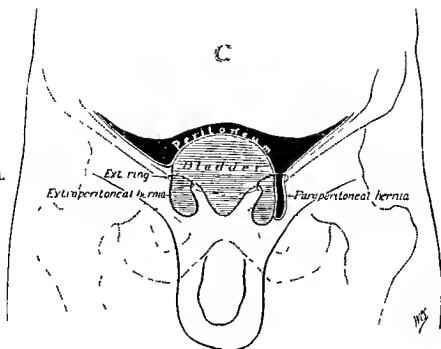


Fig 249B

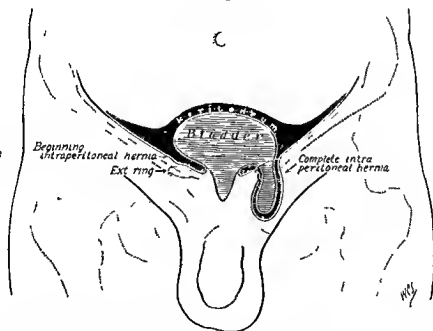


Fig 249A.—Extraperitoneal hernia of the bladder on the right side. It usually remains very small in size. In the inguinal region this variety is always direct. Paraperitoneal bladder hernia on the left side. This is the most frequent variety of bladder hernia.

Fig 249B.—Intraperitoneal hernia of the bladder. This variety is always secondary in origin and has a complete hernial sac.

side of the abdomen has no peritoneal covering. The bladder is outside of the peritoneal sac and not a part of the hernial contents. When peritoneal covered bladder descends into the sac, the peritoneum is adherent to it and closely follows it in its descent. The bladder is almost always found at the inner and posterior part of the peritoneal sac. At operation, an apparent increase in the thickness of the sac is noticed, and dissection is more difficult on the inner side, which is the junction point of the peritoneal sac and bladder.

About 50 per cent of paraperitoneal hernias are thickly covered with fat (*Lipome herniaire* of Verdier). After freeing the cord and reducing the hernia, this mass is sometimes mistaken for a lipoma, a cyst of the cord or a second sac. The more careful the stripping of the sac up to the deep epigastric artery, the more chance there is of discovering cystocele in its early stages. In large hernia in elderly individuals, the normal bladder can often be drawn into the hernial wound without difficulty, owing to the relaxation of the peritoneum. A considerable proportion of paraperitoneal hernias are artificially produced at the time of operation. Imbert has termed these "operative cystoceles."

**3 Intraperitoneal Hernia** (cystocele with intussusception of the bladder—Duret).—Intraperitoneal hernia is rare, but still occurs three times as often as the extraperitoneal variety, and is almost always of the inguinal type. It has a complete hernial sac that enters the inguinal canal external to the deep epigastric artery. The bladder enters this sac completely covered by peritoneum, the portion of bladder involved is almost always the upper part of the posterior surface. These hernias are sometimes very large and are always secondary in origin, the rings are widely dilated. The sac may contain only bladder, or omentum and intestine may be present also. (Figs 250 and 251.)

**Frequency of the Varieties**.—Paraperitoneal is the most frequent variety of bladder hernia, extraperitoneal is next in frequency, and intraperitoneal is the rarest of all. In 386 cases I found 231 paraperitoneal, 120 extraperitoneal, and 35 intraperitoneal. (In the remainder of the cases the variety was not given.)

**Hernial Contents**.—Bladder may be alone in the sac, or in addition to it small intestine and omentum are often found. In rare instances, one or more of the following viscera may be present with the bladder: cecum and appendix, sigmoid, uterus, ovary and tube, prostate, ureters, and urachus. In the extraperitoneal variety, the bladder forms the hernial tumor and has no peritoneal sac.

In 102 cases of hernia of the ureter that I collected from the literature, the bladder was in the sac with the ureter in 20 cases.

**Bladder**.—The amount of bladder in the hernia varies from a small portion of the anterior or lateral wall to the whole of the viscus, all the bladder, except the trigone, has been found in a hernia.

I have seen a large inguinal hernia containing nearly all the small intestine, cecum and appendix, in addition to the bladder. Raymond observed a case of inguinal hernia in which the ovary, tube and bladder were present.



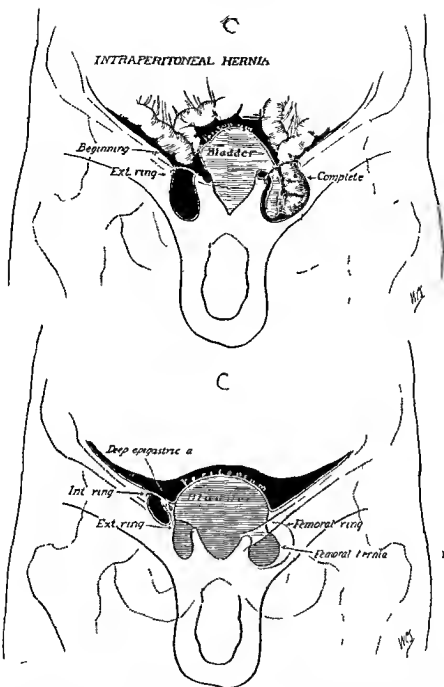


Fig. 250

Fig. 251

Fig. 250.—Hernia of the bladder. A beginning right indirect inguinal hernia. A complete left indirect inguinal hernia containing bladder and intestine. The bladder is intraperitoneal.

Fig. 251.—A right direct inguinal extraperitoneal hernia of the bladder and an empty peritoneal sac in the inguinal canal. A left extraperitoneal femoral hernia of the bladder.

Hernias of the lower portion of the ureter and the whole of the bladder, with the exception of part of the trigone have been reported but they are very rare. Hernia of the isolated tube is very rare it is usually of congenital origin and the tube is often diseased. Opfenheimer in 1943 reported a rare case of carcinoma of the bladder in an incarcerated inguinal hernia.

**Diverticulum of the Bladder**—The portion of the bladder in the hernia is frequently a diverticulum sometimes the opening connecting the herniated bladder with the pelvic bladder is less than  $\frac{1}{4}$  inch (6 mm) in diameter (Fig 252). I believe the diverticula are usually congenital when the neck of the sac is very narrow and the walls are thin.

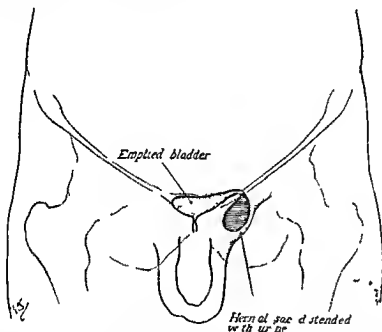


Fig 252—Hernia of the bladder with a narrow diverticulum connecting the cystocele with the pelvic portion of the bladder.

**Prehernal Lipoma**—Prehernal lipoma was first observed by Verdier in 1753 and has been mentioned by many writers. It is a soft lumpy mass or a thickened layer in front of the bladder or simply a collection of lemon colored fat. I believe that the most striking feature of the lipoma is that it is covered by a vascular network of vessels when these are seen during the course of an operation one may be sure that the bladder is nearby and should be on one's guard. The bladder wall can be recognized by its color, vascularity and thickness.

### Etiology

**Predisposing Causes**—The most important causative factors of bladder hernia are age and sex. As early as 1753 Verdier observed that it usually occurred in old men. (It might also be said that anything that dilates the hernial rings or increases the volume of the bladder favors the incidence of this condition.)

*1 Age and Sex*—Bladder hernia is primarily an affection of adult life and old age though it has very rarely been found in young children. I found 38 cases in children under twelve years.

In the 527 cases of hernia of the bladder that I collected from the literature the sex or age was given in 397 patients. Of these 276 were males and 121 were females. Bladder hernia was most frequent in men between forty one and sixty years of age and in women between thirty one and fifty years of age.

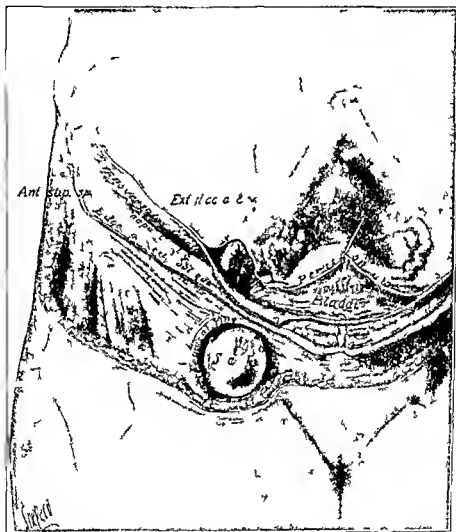


FIG 253—Femoral hernia of the bladder. When a large portion of the bladder is in the hernia sac the ureter is often passed a two inches.

*2 Changes in the Bladder*—Habitual overdistention of the bladder and flaccidity favor bladder hernia. Distention may be due to prostatic disease or to obstruction in the urethra or to a cystitis. When distention continues there is deficient contractility of the bladder which is followed by muscular

atony and flaccidity. The bladder remains permanently enlarged and overlies the hernial orifice, which it may enter, if the latter is widely dilated.

**3 Relaxation of the Abdominal Wall**—The relaxed abdominal wall not only is a predisposing cause of inguinal and femoral bladder hernia but is also a factor favoring protrusions of the bladder through abnormal openings in the linea alba or muscular wall such as occur in postoperative ventral hernia. The closure of the sac at the first operation draws the bladder toward the internal opening and in case the hernia recurs the bladder is liable to be one of the contents of the sac.

**4 Congenital Predisposition**—Congenital predisposition as a cause of bladder hernia was suggested in 1713 by Méry. It is probably a factor in a very small percentage of cases as a large majority of the patients are adults or elderly before the hernia is noticed. It is probable that in some of the cases the bladder does not enter the sac but there is a diverticulum which extends from the bladder through the hernial opening and which in time may become enlarged closely resembling a portion of the bladder proper.

**5 Prevesical Lipoma**—Although Verdier described prevesical lipoma it was not until the studies of Monod and Delagénière that the subject received much attention. This mass of prevesical fat is adherent to the anterior portion of the bladder and according to these authors the bladder is drawn through the hernial orifice by the traction exerted by the lipoma.

**6 Traction of Enterocoele and Omentocoele**—Secondary cystocoele may result from traction of a preexisting hernia or from the protrusion of a flaccid or distended bladder into an old or large hernial sac. This protrusion may be spontaneous or the result of traction following intestinal or omental adhesions.

**7 Hernia of the Bladder in Women**—Inguinal hernia of the bladder is much less frequent in women than in men (32 females to 273 males) while femoral hernia of the bladder almost always occurs in women (73 females to 12 males). The most important cause in women is pregnancy. The pressure of the uterus on the ureter causes disturbances and may favor retention of urine and distention of the bladder. The bladder may be irregular in shape and lie either behind or above the os pubis. Most of the cases have occurred in women who have had one or more pregnancies. (Fig 2c3.)

Abdominal and pelvic tumors may change the relations of the bladder and cause atony and overdistention.

### Symptoms and Diagnosis

The symptoms of bladder hernia are often obscure. In some cases there is a large area of bladder involved and there are definite symptoms but in the majority of cases only a small portion of the bladder is affected and the typical symptoms are lacking. For this reason 93 per cent of the cases that have been reported have been diagnosed at operation. The points of diagnosis can be conveniently divided into two groups—functional symptoms and physical signs.

**Functional Symptoms**—The functional symptoms are chiefly disturbances in urination such as frequent or involuntary micturition or urination in two

stages—*miction en deux temps* The patient first empties the pelvic portion of the bladder, then on pressing the tumor or assuming a peculiar position the urine in the cystocele flows into the pelvic bladder and is voided. In the cases described by Petit and Justo the patients had to lie down to empty the bladder. In Brodier's case the hernia was very large and extended halfway to the knees, in order for the patient to urinate it was necessary for him to lift up the scrotum and compress it. De la Poite's patient with double bladder hernia was compelled to make pressure on both tumors before he could urinate.

Painful urination may be complained of and can often be relieved by assuming certain positions. In rare instances there may be hematuria. Pressure on the tumor is sometimes followed by a desire to urinate. In the case of femoral hernia of the bladder reported by Hietel and Hertel the patient at times suffered severe pain radiating down the thigh as far as the inner side of the knee. The attacks lasted two to three hours and were usually relieved by urination. The bladder was dilated and the patient could retain the urine for twenty-four hours without discomfort. Painful urination was pronounced in the case reported by Fiorini.

**Physical Signs**—A large or moderate sized bladder hernia is generally smooth rounded fluctuating and dull on percussion. The fluid often can be forced into the pelvic bladder by a recumbent position or by firm and continued pressure over the tumor. If a hernial sac contains a bladder diverticulum the opening connecting it to the pelvic bladder may be small and may empty so slowly as to be unnoticeable. The hernia varies in size being larger when the patient has retained the urine for some time and smaller and softer after micturition.

Sometimes fluid can be felt in the mass and there is an impulse on coughing. If bladder alone is in the hernial sac the note on percussion will be dull. If intestine overlies the bladder there is a tympanic sound. In the inguinal variety the hernial opening is always large and out of proportion to the size of the enterocele. In enterocele the cord is intimately adherent to the sac while in bladder hernia it is loosely attached and readily separated from the sac. The neck of the vesical sac is difficult to find being covered by granular and very vascular fat, it is usually found near the pubes. Femoral bladder hernia in women usually becomes larger after each pregnancy and may become permanently irreducible due to the descent of the bladder on the outside of the sac.

Bladder hernia in men is often irreducible especially if it is large and of the scrotal type. Sometimes the intestine and omentum in the sac can be reduced leaving a firm mass which when lifted up with the fingers or compressed becomes softer and fluid can be felt flowing into the pelvic bladder.

Sometimes a sound or a catheter can be passed into the hernia and the tip of it felt just beneath the skin. The bladder can be inflated with air, if the hernia contains bladder it will increase in size become tense and give a tym-

panitic note on percussion The injection of a fluid, preferably sterile normal salt solution, will increase the size of the tumor and make it more tense. Cystoscopic examination will show a large internal opening if a part of the bladder wall is in the hernia; if it is a diverticulum of the bladder that is in

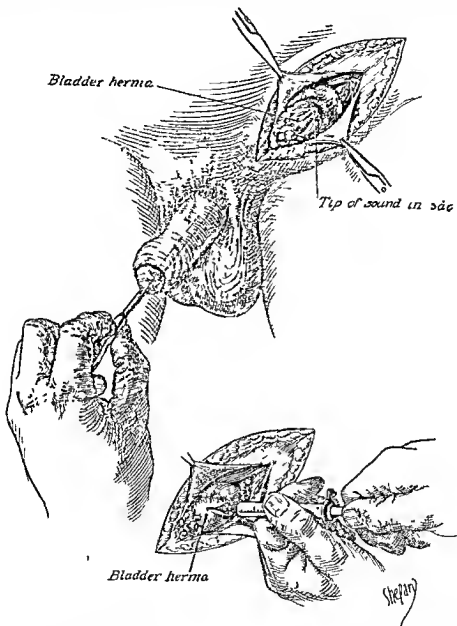


Fig 254.—Recognizing the bladder during operation. A sound can be passed and the tip felt in the bladder hernia or fluid can be safely aspirated with a fine needle inserted obliquely into the bladder wall. Testing with litmus paper will tell at once if it is urine. If this test is not possible a colored solution such as methylene blue can be injected into the bladder through a catheter before the bladder is aspirated.

the hernia, the opening into the pelvic bladder is very small. I was able to make a positive diagnosis in 2 cases, by cystoscopic examination. Bierhoff and Unger have recently reviewed the diagnostic value of cystography.

The value of rectal examination is to be emphasized, the normal bulging of a distended bladder toward the rectum is absent in bladder hernia. If bladder hernia is suspected, methylene blue should be administered for a day before operation, then if the bladder is wounded the accident will be promptly recognized. (It might be added that with the preliminary administration of methylene blue, the simple aspiration of any suspicious looking cystic tumor, by means of the hypodermic needle, will show a blue fluid if the tumor is the bladder (Fig 254).)

**Strangulated Hernia of the Bladder**—The greatest difficulty in diagnosis is encountered in those patients seen for the first time while suffering from strangulated hernia. The symptoms of bladder hernia that may have been present are masked by those of strangulation. A careful study of the history of the case may throw some light on conditions, and if the patient has had difficult or disturbed urination or if the symptoms have been relieved at other times by micturition, one should look for bladder involvement at operation. In rare instances, symptoms of bladder hernia simulating strangulation have been relieved when the patient voided and emptied the portion of bladder that had been pinched in the sac. Femoral vesical hernia may present no symptoms except frequency of urination, and change in the size of the tumor after voiding.

In the paraperitoneal variety, which is the most common form of vesical hernia, intestine and sometimes omentum are also strangulated. The symptoms of intestinal obstruction always overshadow the indefinite signs of bladder strangulation. It is only in the rare extraperitoneal form that the bladder alone constitutes the hernia and when strangulated the diagnosis is problematic because the vesical symptoms are slight and the patient complains of pain over the whole abdomen. There is usually vomiting and some abdominal distention, and the hernia is tender, tense, and irreducible. I collected from the literature 65 cases of strangulated bladder hernia. Of these, 29 were paraperitoneal, 11 extraperitoneal and 6 intraperitoneal. In 19 the variety was not given. Of 49 cases in which the result was given 40 recovered and 9 died—a mortality rate of nearly 20 per cent.

**Calculi in the Herniated Bladder**—Stone in bladder hernia was frequently observed by the old writers, usually being discovered at autopsy. Since the advent of the operation for hernia these cases are seldom seen. When the bladder is closed with nonabsorbable sutures, calculi may form on the sutures if they have passed through the mucosa.

### Differential Diagnosis

**Hydrocele**—Hydrocele is not reducible and is translucent, while bladder hernia is not translucent and reduction can usually be accomplished, which is followed by a desire for urination.

**Enterocoele**—Intestine in the hernial sac gives a soft elastic tumor which is tympanitic on percussion. It is nearly always reducible with a gurgling sound. Bladder hernia appears as a small hard tumor which is dull on percussion, and there are symptoms of disturbed micturition.

**Omentocele**—Omentum in a hernial sac presents a hard irregular mass which is insensitive to pressure. Pressure on the tumor does not cause pain referred to the bladder, or a desire to urinate.

**Cysts of the Cord**—Encysted hydrocele of the cord or of the canal of Nuck is fixed in position or only slightly movable. There are symptoms of disturbed urination and the tumor does not vary in size.

### Prognosis

Hernia of the bladder does not jeopardize the life of the patient unless strangulation occurs and this is unusual. His health may be impaired by the accompanying symptoms of frequent or involuntary urination and cystitis which with the hernia aggravate a possible preexisting prostatitis. There is no expectancy of a spontaneous cure; the tendency is for the hernia to increase in size and the symptoms to become more severe.

If the hernia is reducible and there are decided contraindications to operation a truss or bandage will give temporary relief. Operation is the treatment of choice and the prognosis is good if the vesical hernia is diagnosed before operation or recognized before it is injured. In uncomplicated bladder hernia operations there is a higher per cent of recurrence than in simple hernia operations which is due to the difficulty of closing the large opening left by the bladder.

If the bladder is wounded the prognosis is more serious even if the injury is recognized immediately and the opening closed. The most exact closure is not equal to the unwounded viscus. If the wound in the bladder is not diagnosed until after the operation the outlook is very grave on account of the serious complications that may arise, namely, infection of the wound, leakage of urine into the peritoneal cavity with general peritonitis, extravasation into the subcutaneous tissues and urinary fistula.

Out of 363 cases of bladder hernias in my series studied from a diagnostic standpoint 27 were diagnosed before operation, 293 were diagnosed at operation and 43 were not diagnosed until after operation.

In 241 cases collected by Eggenberger the mortality was 6 to 12 per cent in those cases in which injury to the bladder was recognized at operation and 30 to 40 per cent in the cases in which the injury was not discovered until after operation. In the absence of an autopsy, death following operation may usually be attributed to bladder injury.

### Treatment

Operation is the treatment of choice for hernia of the bladder. It is seldom possible for a patient to wear a truss with any degree of comfort or safety. When a vesical hernia is diagnosed or suspected before operation preliminary treatment directed toward the bladder is advisable—internal antiseptics, bladder irrigations or instillations.

The danger of wounding the nonherniated as well as the herniated bladder during operation must always be borne in mind. Any thickening of the upper part of the sac, especially on the inner side, should be examined most care-



fully. The extraperitoneal variety (*direct inguinal*) is most liable to accident by being mistaken for a hernial sac and incised (Fig 255)

The sac must not be stripped up if it covers a considerable portion of the bladder but excision should be made around the bladder attachment going as high as possible on the outer side where the sac is free. The bladder is loosened gently from its surroundings in order to avoid tearing, returned to the abdomen and the wound is closed by a circular suture or the purse string method (Figs 256 and 257)



Fig 255—Operation for hernia of the bladder. Any thickening of the upper part of the sac especially on the inner side should be examined most carefully. Vascular lemon-colored fat in this situation is pathognomonic of a prehnal vesical lipoma.

After the neck of the sac is stripped up for resection it should be freed of any thickening and should not have an excess amount of fat attached to it. It should not be transixed, ligated or excised until it is completely freed from

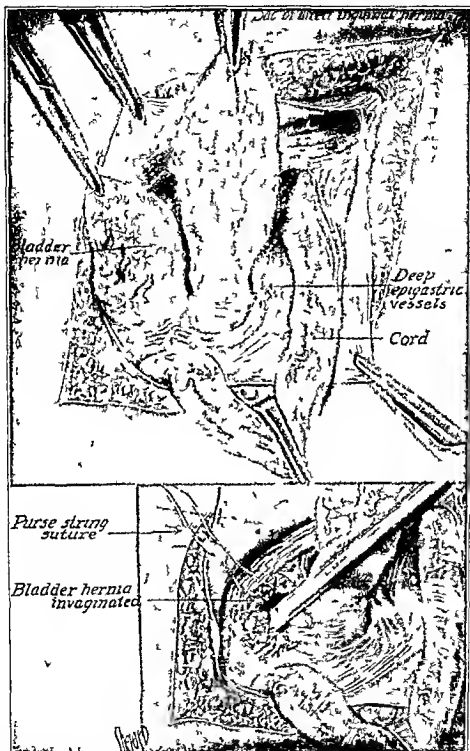


Fig 256.—Operation for hernia of the bladder. The bladder is gently loosened from the direct femoral sac and cord structures. The bladder can be recognized by the yellow preperitoneal fat by the deeper color of the bladder wall and the increased number of tiny blood vessels on its surface.

Fig 257.—The bladder is invaginated into the abdomen and the opening closed with a purse string suture. The hernia is repaired by one of the methods described under the treatment of inguinal hernia.

all surrounding structures. Often the bladder is wounded because it is not seen. The greatest danger lies in cutting away a portion of it after it has been ligated *en masse* with the sac, and not discovering the accident until leakage of urine into the peritoneal cavity sets up a general peritonitis that may appear within a few hours after operation. Death has been known to occur within twenty-four hours after this accident.

**How to Recognize the Bladder During Operation.**—In case it is impossible to identify a suspicious tumor, the quickest way is to open the abdomen above the hernia and examine it from the inside. The hypodermic syringe has proved useful as an instrument of diagnosis. Fluid can be safely aspirated with a fine needle inserted obliquely into the bladder wall, testing with litmus paper will tell at once if this fluid is urine. This test should always be applied to any suspicious looking cyst or hydrocele of the cord.

Sometimes the bladder may be recognized by the yellow prehermal fat or by the deeper color of the bladder wall, and the increased number of tiny blood vessels on its external surface. In direct inguinal hernia the neck of the sac will be internal to the deep epigastric vessels, and a globular swelling may appear on the inner side when the sac is opened. A sound can be passed and the tip felt in the bladder hernia, or the tumor can be distended by inflating with air, or by injecting fluid through the urethra. I have observed that during a hernia operation under local anesthesia if traction on the sac causes the patient to express a desire to urinate, it is a good sign that the bladder is nearby, usually adherent to the inner side of the sac wall.

**What to Do if the Bladder Is Accidentally Wounded.**—If the bladder is accidentally incised, it should be caught immediately with hemostats and a clamp placed across the opening. Compresses should be placed so that the urine will not contaminate the wound or reach the abdominal cavity. The tear or cut should be closed with interrupted sutures of fine silk or cotton in two or three layers, no sutures should go through the mucosa, which should be inverted in closing. (Fig 258.) The bladder is anchored in the lower part of the wound. The tissues that have been contaminated with urine are swabbed with iodine to produce adhesions, and all dead spaces are carefully closed. A drain is inserted down to the bladder and allowed to remain for two or three days. A retained catheter is usually unnecessary, besides being the source of considerable discomfort, catheterization every four hours is sufficient. Argylol should be kept in the bladder—just enough to disguise the bloody urine so that the patient is unaware of the accident.

If the bladder injury is not recognized for twelve to thirty-six hours after operation, the prognosis is grave. One should suspect vesical injury in the presence of frequent and painful urination, vesical tenesmus, bloody urine *per urethram*, or oozing through the dressings. If urine is entering the abdominal cavity the symptoms will be those of a fulminating general peritonitis. The wound must be opened immediately, the bladder injury found and sutured.

**Strangulated Bladder Hernia.**—Strangulated bladder hernia is a serious complication and calls for immediate operation. Fortunately it is rare, be

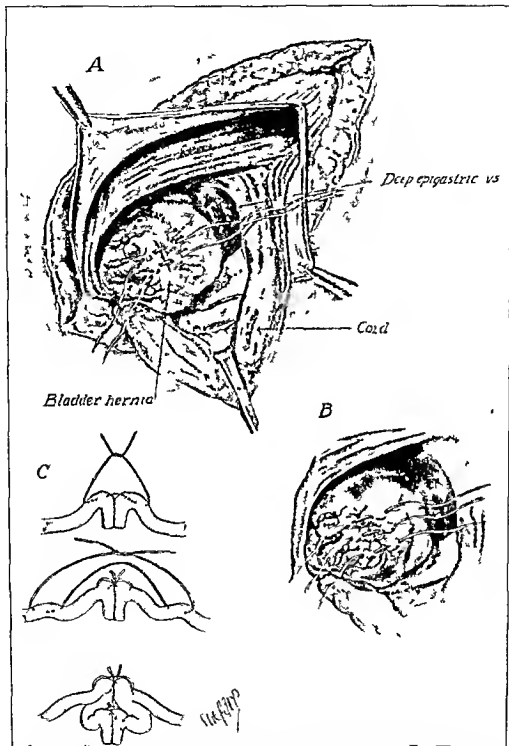


Fig. 258.—Operation for hernia of the bladder. When the bladder is wounded the tear or cut should be closed in two or three layers with interrupted sutures of fine silk or cotton. No sutures should go through the mucosa, which should be inverted in closing. Non-absorbable sutures must never be used. (A) The first layer of Lembert sutures. (B) The second layer of Lembert sutures. A third layer should be inserted if the wound is large or if the peritoneal cavity has been opened. (C) Cross section showing the layers of suture before and after tying.

cause hernia patients seek treatment nowadays before the hernia becomes large and irreducible. The usual point of constriction is at the free edge of Gimbernat's ligament.

**Stone in the Bladder**—If calculi are discovered either in the bladder or in a diverticulum, which may be in the sac, an incision should be made through the vesical wall, the stones removed, and the bladder edges sutured.

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## CHAPTER XXXIV

### HERNIA OF THE URETER

#### Synonym—Ureterocele

**Definition**—A hernia of the ureter is a protrusion of the ureter through a normal or an abnormal opening in the abdominal or pelvic wall

Hernia of the ureter is very rare, and only a few cases have been reported in the literature. Harris observed the following case which has not been reported. A man, aged fifty three years, presented a right inguinal hernia of two years' standing. On examination, a lipomatous mass twice the size of a hen's egg was found in the right inguinal region, but it did not extend into the scrotum. At operation under local anesthesia, the mass was found to consist of two distinct parts. The smaller part, which measured  $1\frac{1}{2}$  by  $3\frac{1}{2}$  inches (4 by 8 cm), was just to the inner side of the cord, and the larger part, which measured  $2\frac{3}{4}$  by 4 inches (6 by 10 cm), lay to the inner side of the small one. The fat was thickest on the inner side of the sac, and traction on it pulled on the bladder. The right ureter looped down on the outer and anterior surface of the inner mass and was partly embedded in fat. The lipoma and sac were excised, the ureter and protruding bladder returned to the abdomen, and the hernial opening was repaired. The patient made an uneventful recovery. (Fig 259)

#### Historical

In early times no attempt was made to distinguish hernia of the ureter from bladder hernia. Reichel, in 1692, wrote on this type of hernia and reported a case that attracted general interest. Important papers appeared in the literature by Gelpke, in 1897, Rolando, in 1904, A. Carl, in 1905, Brunner, in 1907, Meissner, in 1907, Caccia, in 1908, Dardimeli, in 1910, Ross, in 1921, Micotti, in 1926, Moscheowitz, in 1932, C. Carl, in 1932, and Rozanov, in 1934.

Avieroli, in 1935, published an excellent review on hernia of the ureter. Røvig, in 1935, also reviewed the literature and recorded an unusual case. Biasini, in 1935, reported 4 cases. Fernandez, in 1936, reviewed the reported cases. Dourmashkin, in 1937, wrote on the historical aspects of this form of hernia. Gayet and Cavaillier, in 1938, wrote on the symptoms and diagnosis. Gopalan, in 1940, observed a case. Slany, in 1940, reported a hernia of the ureter in a twelve year old boy. Haber, in 1946, reported a case. Bitschai, in 1947, writes that hernia of the ureter is often seen in Egypt.

#### Statistics

I collected from the literature, in 1946, the records of 102 cases of hernia of the ureter and studied the histories of 81 cases.

	MALES	FEMALES
Right inguinal	32	6
Left inguinal	5	3
Right femoral	2	24
Left femoral	2	7

## RELATION TO PERITONEUM

Paraperitoneal	59
Extraperitoneal	10
Not stated	16
Bladder also in hernia	20

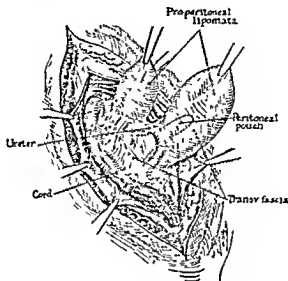


Fig. 252—Inguinal hernia of the ureter (Courtesy of Dr. M. L. Harris.)

### Anatomy

The ureter in a hernia is usually normal in appearance, and is especially likely to be so when it accompanies the bladder into the sac. The ureter is nearly always found in contact with a good-sized mass of fat.

**Anatomical Varieties.**—There are two anatomical varieties of hernia of the ureter:

1. The paraperitoneal variety, in which the hernia has a peritoneal sac.
2. The extraperitoneal variety, in which the sac is absent. In both varieties the ureter may be alone, or it may be accompanied by the bladder.

As a rule, the ureter lies behind the sac and accompanies a hernia of the intestine or omentum.

**Clinical Varieties.**—From a clinical standpoint, hernia of the ureter is divided into two varieties:

1. Hernia of the ureter alone.
2. Hernia of the ureter associated with other viscera, usually with the bladder.

Brunner observed an isolated hernia of the ureter in which the loop was 8 inches (20 cm.) long.

### Etiology

Practically all the recorded cases of hernia of the ureter have been caused by the ureter sliding into the sac, in very much the same manner that a sliding



hernia of the large intestine slips into the sac. It is very difficult to produce hernia of the ureter experimentally on the cadaver, it is much easier to make the ureter enter the femoral canal than the inguinal canal.

Extraperitoneal hernia of the ureter is probably congenital. The paraperitoneal variety may be due to an unobliterated peritoneal process which draws the ureter into the hernial canal either by traction on underlying tissues or as a result of adhesion of the ureter to the posterior wall of the sac. When the portion of the bladder adjacent to the ureter is in the sac, it is usually due to traction exerted by the ureter.

**Age**—A majority of cases of hernia of the ureter have been observed in subjects between forty and sixty years of age.

**Sex**—Hernia of the ureter occurs in both sexes with about equal frequency. Of 102 cases I collected from the literature, 42 were in females and 41 in males.

**Site**—Hernia of the ureter most often occurs in the inguinal region. I found 46 of the inguinal to 35 of the femoral variety. The inguinal variety nearly always occurs in men, and the femoral in women. Only 9 cases of inguinal hernia of the ureter have been observed in females, and only 4 cases of the femoral variety in males. Røvig reported the case of a woman, aged thirty years, with a femoral hernia containing the ureter.

Hernia of the ureter alone is most frequently femoral, while hernia of the ureter and bladder is usually inguinal. Gelpke observed the only case of femoral hernia of the ureter and bladder that has been reported.

### Symptoms

There are no characteristic symptoms of hernia of the ureter, and none of the reported cases have been diagnosed prior to operation. Sometimes there is a history of disturbances in urination. The patient observed by Ross and Taylor had had frequent micturition for two years. Rarely there may be hematuria, and pain in the lower abdomen or lumbar region if there is a complicating hydronephrosis. The possibility of hernia of the ureter should be thought of when there is a hard, cordlike, incompletely reducible mass in the hernial canal, especially if it is associated with an empty sac. When the loop of ureter in the hernia is very much dilated the cystic tumor is dull on percussion, there is no gurgling when it is reduced, and sometimes the fluid can be felt as it is forced out of the dilated loop. Pressure of a truss pad on the ureter may result in a lessening of the quantity of urine voided and the removal of the pressure is followed by an increase in amount.

Cystoscopic examination and catheterization of the ureter offer the best prospect for a preoperative diagnosis. When ureteral catheterization is possible, an obstruction is encountered in the region of the hernia. If the catheter passes through the herniated loop, it reenters the abdomen, and in case of hydronephrosis a large amount of urine is evacuated. Roentgen ray examination, with the catheter in the ureter, will enable the examiner to make a positive diagnosis of hernia of the ureter. In the cases reported by Reichel and Meissner,

catheterization of the ureter was impossible on account of stenosis. Hydro-nephrosis as a complication of hernia of the ureter is not common. As stated by Rossi, preoperative diagnosis of hernia of the ureter is almost impossible.

### Differential Diagnosis

Hernia of the ureter must not be mistaken for hernia of the appendix, hernia of Meckel's diverticulum, bladder diverticulum, hydrocele of the cord, adherent omentocoele, or enterocoele.

### Treatment

If the ureter is identified before it is wounded, it should be freed and returned to the abdominal cavity. In femoral hernia identification is usually very difficult. If the presence of the ureter is suspected, the operator should make an inguinal incision and look for the remains of the umbilical artery, and in females, for the round ligament also. In order to reduce femoral hernia of the ureter, it is sometimes necessary to cut the inguinal ligament.

If the ureter is wounded, it should be repaired by longitudinal or transverse interrupted sutures. When it has been completely divided, the ends may be united by end to end anastomosis, or by one of the methods used in general surgery for wounds of the ureter, or the distal end can be implanted into the bladder (see accidents of inguinal hernia operations).

Caccia stated that implantation into the bladder is indicated when the ureter is considerably dilated and has lost the power of contraction. Rolando believed that implantation should always be done when hernia of the ureter is complicated by a hernia of the bladder. When the ureter is thick, dilated, or when it cannot be replaced in the abdominal cavity, resection of a portion of it is indicated.

If the ureter is dilated, stenosed or diseased, the kidney on the affected side should always be examined for hydronephrosis, and, if it is extensively involved, it should be removed, provided of course, that the operator is certain the other kidney is normal. If a fistula develops following a wound of the ureter, a second operation will be required to implant the ureter into the bladder. In Meissner's case, resection of the ureter was necessary because of the stenosis. After operation, Moscheowitz advised elevating the foot of the bed to straighten out the ureter.

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## CHAPTER XXXV

### HERNIA OF OVARY FALLOPIAN TUBE, AND UTERUS

**Synonyms**—Hernia of the ovary    *hernia ovarialis*, *ovariocele*, *oöphorocele*

Hernia of the fallopian tube    *tubal hernia*

Hernia of the uterus    *hysterocele*, *hernia uteri*

**Definition**—A protrusion of the ovary, fallopian tube or uterus through a normal or an abnormal hernial opening

The internal genital organs of the female found in hernial sacs in the order of their frequency are as follows    the ovary and tube, the ovary, the tube without the ovary, the nongravid uterus, and, least often, hernia of the pregnant uterus    Since herniorrhaphy has become a common procedure, abnormal contents of the sac are being found with increasing frequency

#### Historical

**Ovary and Tube**—The first case of hernia of the ovary is reported in the writings of the Greek physician Soranus, of Ephesus about A.D. 97 "Some, as is claimed by Chios say that there are also suspensory ligaments attached to the ovaries    We ourselves have verified this fact by experience in the case of a woman affected with intestinal hernia, with that woman there occurred, during the operation a prolapse of the ovary following the relaxation of the vessels that retained and enveloped it and with it the suspensory ligament also escaped "

Although there is no record of hernia of the ovary, tube and uterus in literature for the next fifteen hundred years following this early report, it probably occurred just as frequently as it does today    The first authentic record of hernia of the internal genitalia is Pol's case reported in 1531, of hernia of the pregnant uterus, and a similar one observed by Sennertus in 1610    The first mention of hernia of the fallopian tube was probably made by Lavater, in 1672    The next case was reported in 1716, when de Gouey observed a large hernial tumor which was probably one of ectopic gestation

Deneux, in 1813, collected from the literature 12 cases of hernia of the ovary, 9 of these were inguinal    He believed that hernia of the ovary was always accompanied by the tube and was of congenital origin    Loumagne, in 1869, was able to find records of 15 cases of hernia of the ovary and tube    The following year Hamilton reported 12 new cases of hernia of the ovary    In 1868 English found in the literature 38 hernias of the ovary, 27 of these were inguinal    Seven years later Puech collected 65 cases of congenital inguinal hernia of the ovary, and in 1879 he was able to find a total of 106 cases    By this time hernia of the ovary was not regarded as a rare condition, but as one to be looked for

**Uterus**—In 1610 Sennertus reported 2 cases of inguinal hernia of the pregnant uterus    From a careful study of all available records, I believe that one of these 2 cases is the same as the case previously observed by Pol (1531)

and that it is simply reported again by Sennertus. The occurrence of hernia of the uterus with one tube and ovary was mentioned by Boyer in 1822, by Boivin and Dugès in 1834, and Cormack in 1841. Eisenhart, in 1885, made a thorough study of 12 cases of hernia of the uterus that he was able to collect from the literature. An important paper by Adams appeared in 1889. Kustner, in 1897, was able to find 15 cases in the literature, and Hilgenreiner, in 1906, collected 8 additional cases.

Baricci, in 1926, reported a very rare case of femoral hernia of the fallopian tube and a bladder diverticulum. Orr, in 1929, reviewed the literature on hernia of the ovary and tube. Capocchi, in 1930, presented an excellent historical review of the subject. Harbeson, in 1933, discussed the embryology of hernia of the ovary. Cleuet, in 1935, wrote on strangulation of the ovary and fallopian tube in a young infant. The same year, di Franco and Bueno observed a femoral hernia of the ovary and tube and reviewed the literature. Cartaya, in 1936, found a pregnant uterus strangulated in a postoperative abdominal hernia. Bowen, in 1938, added another case of femoral hernia of the ovary to those already reported. Rocher, in 1939, published an important study of ten personal cases. In 1939, Degiorgis reviewed the literature on hernia of the tube and ovary in infants, and another summary on the same subject was published by Matassi, in 1940. Mayer and Templeton, in 1941, wrote on ectopia of the ovary and tube and reviewed the literature. Del Campo, Guarnelli, and Canabal, in 1941, studied the causes of strangulation in infants and reported a case. Ravagnan, in 1942, reported an unusual case of femoral hernia of the ovary and fallopian tube and collected the reported cases. Carter, in 1947, reported an unusual case in an infant nine months of age. McCarty, in 1947, reported a sliding hernia of the ovary and tube.

McMillan in 1942, reviewed the literature and reported a case of hernia of the uterus. Labaudibr, in 1942, reviewed the published cases of hernia of the ovary and tube. Senra, in 1943, reported a case of hernia of the uterus and summarized others in the literature, and the next year Laird observed the case of a patient with a strangulated hernia of the pregnant uterus. de Luccia, in 1944, reported the case of a seventeen year-old girl with strangulation of the ovary and tube in a left inguinal hernia with pain in the hernia from the time she was fifteen days old.

In 1945, Van Meurs recorded a rare case of obturator hernia of the ovary and fallopian tube. Bancroft reported cases of ectopia of the ovary and tube, Conti and Saleo observed a case of inguinal ectopia of the uterus, ovary, and tube, and Boys saw a strangulated hernia containing a pregnant uterus at term.

**Infants and Children**—Hernia of the ovary and fallopian tube, while rare, has been found in very young infants. I found a record of the tube alone in an infant one day old, the ovary alone in a patient three days old, and in one six days old, the ovary and tube in two patients seven days old, the ovary alone in 5 patients one month old, and 5 cases of ovary and tube in infants one month old. Vial and Bergeron's little patient was forty one days old, Matassi's patient was two months old, and Fridjohn and Lee's was three months of age, as was Cleuet's patient. Roseby's patient was four months old, while Martinez found hernia of the ovary in two very young sisters, probably congenital in origin.

In my collected cases there were 94 infants 6 months old, or less. In 5 of these, the uterus was contained in the hernial sac.

**Ectopia of the Ovary**—Ectopia of the ovary is due to an anomalous embryological development of the genital system with maldescent of the ovary. The condition is often associated with other congenital malformations. Ectopia of the ovary is accompanied by the fallopian tube, while hernia of the ovary is usually found in the sac along with intestine or other abdominal viscera.

### Statistics

In 1946, I collected the records of 686 cases of hernia of the ovary, tube, and uterus, including my own.

**Site of the Hernia**—In 588 cases the site of the hernia was given as follows:

SITE	VARIETY NOT GIVEN		INGUINAL				FEMORAL				OTHER VARIETIES	TOTAL CASES
	R	L	R	L	BILAT	SIDE NOT GIVEN	P	L	BILAT	SIDE NOT GIVEN		
Ovary and tube	0	1	81	88	11	18	10	0	0	2	Obturator 0 Sciatic 2 Perineal 2	234
Ovary alone			51	34	18	47	11	8	1	4		174
Tube alone			23	13	1	7	17	4	0	3	Obturator 7	77
Nongravid uterus			17	31	5	10	6	2				71
Gravid uterus			6	7	0	1	2	1			Ventral 10 Umbilical 5	32

**Age**—The age was given in 525 patients as follows:

AGE	OVARY AND TUBE	OVARY ALONE	TUBE ALONE	NONGRAVID UTERUS WITH OVARIES OF TUBES	GRAVID UTERUS
1 day			1		
3 days		1			
6 days					
1 week	2			1	
2 weeks		1	1		
3 weeks		1	2		
1 month	5	5			
2 months	13	14		2	
3 months	11	4			
4 months	5	6	1	1	
6 months	11	5	11	1	
9 months	5	3		1	
1 year	24	30	4	6	
1 to 2 years	22	2	1	0	
2 to 10 years	14	10	1	0	
11 to 20 years	17	18	2	4	1
21 to 30 years	23	19	12	13	5
31 to 40 years	30	6	13	7	6
41 to 50 years	17	15	11	7	4
51 to 60 years	5	6	8	2	
61 to 70 years	6	2	3	3	
71 to 80 years	1	2	4	1	
81 to 90 years	1	0	0	2	
Total	412	171	75	51	16

**Treatment**—The result of treatment was given in 421 cases as follows

	TOTAL CASES	EXCISION		REDUCED		OPERATION	
		R	D	R	D	R	D
Ovary and tube	190	117	7	58	1	13	0
Ovary alone	144	61	0	81	0	2	0
Tube alone	32	25	3	0	0	4	0
Nongravid uterus (usually one cornu) ovaries or tubes	40	18	0	20	2	8	1
	411	221	10	159	3	27	1

R = Recovered. D = Died.

In 68 cases of hernia of the nongravid uterus the sac contents were as follows

Uterus alone in sac	7
Uterus and one ovary	10
Uterus and two ovaries	2
Uterus, ovary and tube	29
Uterus, two ovaries and two tubes	15
Uterus and tube	3
Uterus and two tubes	2

In 19 cases the uterus was rudimentary or only one cornu was in the hernial sac

**Hernia of the Pregnant Uterus**—In 14 cases the time the uterus entered the hernial sac was given

Before conception	2
At the 3rd month	4
At 4½ months	1
At the 6th month	1
At the 7th month	2
At the 8th month	2
At the 9th month	2

## Anatomy

### Site of Hernia of the Ovary and Tube —

1 *Inguinal*—Ninety five per cent of the hernias of the ovary and tube are of the inguinal variety. The hernia is most frequently on the left side, it is rarely bilateral. I found 11 cases of bilateral hernia of the ovary and tube, 18 of the ovary alone, and 1 of the tube alone (Fig 260)

2 *Femoral*—I found 18 cases of femoral hernia of the ovary and tube, 24 of the ovary alone, and 24 of the tube alone

3 *Obturator*—In this series there were 16 obturator hernias, 9 of the ovary and tube, and 7 of the tube alone. Chiene observed the only bilateral obturator hernia of the tubes alone

4 *Sciatic*—Sciatic hernia of the ovary and tube is very rare. Only two cases have been recorded. The first one was reported by Camper, and the second, by Chénieux, in the latter case a large ovarian tumor was found

**Site of Hernia of the Uterus**—Hernia of the nongravid uterus is almost always inguinal. Hernia of the pregnant uterus is inguinal, femoral, umbilical, or ventral

### Hernial Contents.—

*Hernia of the Ovary and Tube.*—Inguinal hernia of the ovary without the tube is infrequent; in the femoral variety, the ovary is often not accompanied by the tube. Hernia of the ovary and tube is the most frequent variety. Most of the cases occur in children under two years old. The ovary or tube may be in the inguinal canal, or outside the external inguinal ring with equal frequency; but, when intestine is present in the sac, the ovary is outside the ring. In some cases the ovary is accompanied by intestine; in a majority the ovary and tube are the sole contents of the sac.

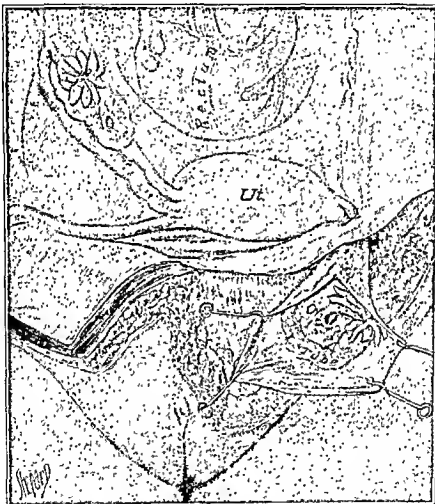


Fig. 260—Inguinal hernia of the ovary and tube.

*Pregnancy in the Tube.*—Of the 77 cases of hernia of the tube, there was tubal pregnancy in 11; in 6 of these the tube was alone in the hernial sac, and in 5 the ovary was also present.

A hydrocele may be found in the sac with the ovary or tube occluding the neck. Neboux saw this condition in an inguinal hernia. Camper reported a case of hydrocele in a femoral hernia with the ovary adherent in the neck of the



sac, Béniard saw a case in which the tube occluded the femoral opening, and the hydrocele contained nearly a gallon of fluid

*Hernia of the Uterus*—Hernia of the uterus hardly ever occurs alone, and is most frequently associated with hernia of the ovary and tube, usually of the side on which the hernia appears. The uterus and both ovaries and tubes have been found infrequently in the same sac, they were present in 14 of the cases I collected. Bilateral hernia of a bicornate uterus is very rare, I found 4 cases of the inguinal variety. Intestine and omentum are usually present in hernia of the nonpregnant uterus. Sliding hernias of the ovary and tube have been described by Papai and Adam.

Nilson reported a case of hernia of a uterus in a young man and made a study of the cases reported in the literature. These hernias have not been included in my statistics as it has been thought advisable to limit this group of hernias to their incidence in females.

### Pathology of the Hernial Contents—

1 *Ovary and Tube*—The changes in the sac are similar to those found in other types of hernia. On account of the frequency of suppurative diseases of the tube, abscess is sometimes found in the sac. In hernias of short duration, the ovary is usually normal. On account of its exposed position it is subject to trauma and disturbances in circulation, it may become inflamed, tender and painful. Atrophy may occur, but it usually is not severe enough to check ovulation or menstruation. Several instances are on record in which a pregnancy has occurred in a preexisting hernia of the ovary, tubes and uterus. The most frequently observed pathologic change in the ovary is cystic degeneration. Malignant degeneration of the herniated ovary was reported in 4 of the cases I collected. Tuberculosis of a herniated ovary is rare, I have found only a few cases reported in the literature.

2 *Round Ligament*—The round ligament may accompany the ovary and tube into the sac, and in rare instances it is the cause of strangulation. Chevrrier and Dardanelli have written important papers on hernia of the round ligament.

3 *Uterus*—The uterus is rarely normal. It is usually elongated, it may be anteverted or retroverted, sometimes it is twisted upon itself or there may be a lateral version, or there may be a uterine fibroma. Malformation, such as rudimentary uterus, is common, the uterus may be unicornate or bicornate. In 14 cases of hernia of the nonpregnant uterus, that I collected, the uterus was rudimentary. The vagina is frequently imperforate. In a few of the reported cases the patients were pseudohermaphrodites, true hermaphroditism is rare.

### Etiology

*Ovary and Tube*—The cause of hernia of the ovary and tube is not known. The principal factor is probably congenital predisposition, as a majority of these hernias are observed at birth or soon after. Of 174 cases reported by Macready, 134 of the patients were under five years of age. Of the 367 cases I collected, 161 were under ten years old. A majority of the inguinal

hernias in little girls contain the ovary and tube. Congenital development of these hernias is favored by the proximity of the ovary to the hernial opening and by the mobility of the ovary and tube which may have an abnormally long broad ligament. The canal of Nuck may remain open for some time after birth or even throughout life although it is normally obliterated about the eighth month of fetal life. During intruterine life the internal genital organs are above the pelvic cavity. At the sixteenth week of fetal life the ovary lies in the

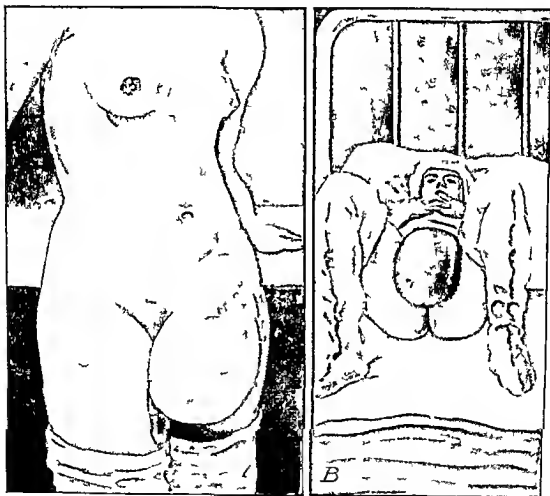


Fig. 261—Irreducible inguinal hernia of the pregnant uterus

lumbar region and it descends to the iliac fossa about the twentieth week. According to Puech this is the most favorable time for the ovary to enter the inguinal canal. The ovary is usually not in the pelvis at the end of the first year of life. The left ovary slightly precedes the right in their descent and the condition is analogous in a way to the descent of the testicles although the round ligament becomes longer instead of shorter as is the case with the gubernaculum testis. As a matter of fact there is no similarity between the descent of the testicle and the eventration of the ovary in inguinal hernia because the testicle

is retroperitoneal, and the ovary is intraabdominal and has a free mesentery. Conditions that favor the development of a hernia of the ovary and tube prevail until about the tenth year, when the ovary finally descends to its permanent position in the pelvis.

An acquired hernia is favored by a patent canal of Nuck and by the relaxation of the parietal peritoneum which predispose to sliding hernia, in which the hernial contents are drawn into the posterior part of the sac by means of their natural peritoneal attachments.

Exciting causes may be a fall, a strain, such as whooping cough or bronchitis, and laborious occupations. The cause of hernia of the tube alone is not known. It is probable that it is produced by the same conditions that cause hernia of the ovary and tube, and something occurs to prevent the ovary from entering the hernia. The hernial opening is perhaps too small or the ovary may be too large, or it may be held down by its greater weight and lower position. Kousmine measured the tubes in cadavers of newly born infants and found the middle of the tube was 14 mm from the inguinal orifice, while the fimbriated extremity was 13 mm from the femoral opening. This led him to agree with Cruveilhier that the tube precedes the ovary in descent.

**Uterus**—Hernia of the uterus is found most frequently in women who have borne several children. It may be congenital or acquired, the congenital variety is very rare. The hernia usually occurs in a patient who has a large inguinal or umbilical hernia. Pressure of nearby tumors or displacements of the uterus or adnexa may also be causative factors. A preexisting hernia of the ovary and tube may become adherent to the sac, and as the hernia enlarges, the uterus is drawn into the sac. Hernia of the pregnant uterus (*hysterocele gravidarum*) is infrequent. The uterus may become impregnated while in the hernia, as occurred in one of the cases I collected, or it may enter the hernial sac during pregnancy, and as it enlarges the hernia becomes irreducible. (Fig 261.)

### Symptoms and Diagnosis

**Ovary and Tube**—The symptoms of hernia of the ovary and tube are practically always confined to the ovary alone and depend largely upon the age of the patient. In the infant and the child the ovary appears as a hard *oval tumor the size of a pea, or a little larger, and is freely movable*. It may lie in the inguinal canal or outside the external ring in the labium majus, it may be reducible or irreducible. Intestine is present in only about 15 per cent of irreducible hernias of the ovary and tube. The diagnosis of an inguinal hernia in a female child is usually easy, as it almost always contains only the ovary and tube, omentum being a very rare content. It causes little discomfort, and is seldom painful, although in the case described by Bouffroy, pressure on the hernia caused epileptic convulsions.

In the adult the subjective symptoms are more pronounced. While the normal ovary is insensitive the herniated ovary is sometimes hypersensitive probably on account of the constant irritation due to its exposed position. It may be painful on palpation and even becomes turgescient, with referred sensa-

tions or pain in other genitalia. Swelling and pain in the ovary are usually most pronounced at the menstrual period. Occasionally the external ovary is small, atrophied, and insensitive to manipulation and pressure. In certain instances the pain may be so severe that excision of the ovary is required to relieve it.

The diagnosis is more difficult in adults because the hernia is larger and often contains intestine and omentum, and the presence of the internal genitalia is less constant than in children. The most valuable means of diagnosis, as pointed out by Lassus is vaginal or rectal examination. The uterus is found displaced to the same side as the hernia. A uterine sound is often helpful to determine the position of the uterus. The ovary can be moved by displacing the uterus posteriorly, or to the opposite side. In the event of a bilateral hernia both ovaries should be displaced by tilting the uterus first to one side, and then to the other.

Hernia of the tube alone seldom causes symptoms except those following traction on the ovary or uterus. The tube may rarely become sensitive during menstruation. The diagnostic signs are the same as those of hernia of the ovary, the condition is practically never diagnosed prior to operation. Five cases of tubal pregnancy in a hernial sac have been recorded in the literature. Birman called attention to the danger of rupturing the tube from attempts at taxis and producing a general peritonitis.

**Uterus**—Hernias of the uterus are very rare in children. I found 22 cases in infants under a year old but none between the ages of one and ten years. Most of the other cases on record are found in true or false hermaphrodites these I did not tabulate.

Hernias of the nonpregnant uterus are most frequent after the menopause. They may be reducible or irreducible. Strangulation is rare and complications are infrequent. The symptoms in these cases may be due to the presence in the sac of the ovary and tube along with the uterus. Diagnosis is aided by vaginal examination and sometimes the passage of a uterine sound is helpful.

Hernia of the uterus complicated by pregnancy presents few symptoms before the fourth month when the signs of uterine pregnancy are demonstrable, namely the fetal heart beat, the outline of the parts and fetal movement. In the inguinal variety, there is usually a history of a large reducible tumor, which does not become irreducible until the pregnancy is well along while in the umbilical type the pregnant uterus usually does not enter the hernia until the latter half of pregnancy and may not become irreducible until the onset of labor. This form of pregnancy not infrequently terminates in abortion.

### Complications

The most common complication is irreducibility of the ovary sometimes accompanied by torsion of the tube which if not diagnosed and operated on, may lead to strangulation. de Luccia has stated that a small irreducible or painful hernia accompanied by severe pain at menstruation should lead one to suspect hernia of the ovary. Infection of the sac and adnexa are infrequent sequelae of this type of hernia.

*1 Torsion of the Adnexa*—Torsion of the adnexa is a frequent complication of hernia of the ovary and tube in children under two years of age. The symptoms are indefinite—crying, restlessness and irritability, vomiting and tympanites are rare. There is an irreducible tumor in the hernial region, which is swollen, tender and painful. If the torsion is long continued or severe, strangulation is liable to occur. Muller reported the case of an infant, five months old, whose left ovary and tube had been removed on account of strangulation, five weeks after this was done a hernia of the tube and ovary appeared on the right side. On account of the strangulation an operation was performed and the tube and ovary were returned to the abdominal cavity and the hernial opening closed. Dustace and McNealy saw a case of strangulated inguinal hernia of the ovary and tube in an infant six months old. The right labium majus was red, swollen, tender, and pitted on pressure, there was no fluctuation or pulsation in the mass. At operation a torsion of 180 degrees of the tube and ovary was found. The adnexa were resected, and the child made an uneventful recovery.

*2 Strangulation*—Strangulation is almost always due to torsion of the pedicle and not to constriction by the hernial ring and it is usually manifested by a tender, painful, irreducible mass unless intestine is present, when there will be symptoms of nausea, vomiting and constipation. The mass tends to increase in size and may resemble a strangulated omentocoele. In some instances there is no pain, and strangulation is not discovered until during the course of an operation for a supposedly simple irreducible hernia. Peritonitis is rare. In a few instances the tube is strangulated at the internal inguinal ring. Retrograde strangulation of the fallopian tube is very rare.

*3 Abscess in the Hernial Sac*—Suppuration sometimes occurs as a result of infection from the fallopian tube which may also involve the ovary.

### Differential Diagnosis

Hernia of the ovary, tube and uterus may be mistaken for a variety of conditions because of the frequency of congenital malformation in the internal genitalia, as well as other developmental anomalies. The presence of hermaphroditism or pseudohermaphroditism is not rare, and for this reason a testicle may be mistaken for the ovary and tube.

*Enterocoele*—Intestinal hernia is resonant, and is usually reducible with a gurgling sound. If it is irreducible, the symptoms are those of intestinal obstruction or strangulation. Omentum adherent in the hernial sac may confuse the diagnosis. If the hernia contains intestine, omentum, ovary, and tube, a diagnosis is almost impossible unless the intestine and omentum can be returned to the abdominal cavity, and movement of the ovary obtained by vaginal examination.

*Cysts of the Canal of Nuck*—Cysts in the canal of Nuck are fluctuating translucent, and irreducible. Vaginal examination shows the uterus and adnexae in their normal position. Holloway has reviewed the literature on the subject.

**Cyst of the Round Ligament**—This condition, while very rare, is usually diagnosed as inguinal hernia. Palpation reveals a soft fluctuating mass that gives no impulse on coughing, as in the case reported by Martin, who reviewed the literature on cysts of the round ligament simulating hernia.

**Endometriosis of the Round Ligament**—This condition although rare, may at times be present as emphasized by Dickinson. It may be an adenomyoma or a hemorrhagic cyst. The latter is usually reducible while the former condition is nonreducible. Endometriosis was first described by Cullen in 1896. Mahorner observed a case of cyst of the round ligament in a hernia that was mistaken for an endometrial cyst.

**Abscess**—Strangulated hernia of the ovary and tube simulating abscess in the labium majus is difficult to diagnose in infants.

Other conditions that may simulate hernia of the ovary and tube are dermoid cyst in the canal of Nuck, enlarged lymph glands, lipoma which is soft, insensitive and irreducible, cyst of the labium majus, and a tag of omentum, which is usually found attached to the upper part of the inguinal canal.

The nongravid uterus in a hernial sac is usually difficult to diagnose, and is hardly ever looked for unless it causes symptoms. Its presence can sometimes be detected by vaginal examination or by passing a uterine sound which enters the hernial sac. Hernia of the pregnant uterus may be mistaken for extrauterine pregnancy. When examination discloses the nongravid uterus in the abdominal cavity displaced toward and connected with the gradually enlarging tumor in the hernial sac the condition is probably extrauterine pregnancy.

### Prognosis

Hernia of the ovary and tube is not dangerous to life. While some cures result from truss treatment in infancy, they are very rare after the second year. The truss aggravates and hastens the degenerative changes which always occur in ovaries in this exposed position. The best outlook for the conservation of the ovaries is by immediate operation as soon as diagnosis is made. After puberty there is always the danger of extrauterine pregnancy.

The prognosis of hernia of the nongravid uterus is serious because of the danger of complications. The uterus in a hernial sac is more likely to undergo malignant change than a normal uterus and should pregnancy occur in an inguinal hernia of the uterus a normal delivery is almost always impossible and hysterotomy must be resorted to. Pregnancy in an umbilical hernia is less grave because the neck of the sac is larger and the hernia can usually be reduced even after the onset of labor.

The operation for hernia of the ovary and tube has had a low mortality even in preantiseptic days because of the fact that the operation is usually extraperitoneal.

### Treatment

**Hernia of the Ovary and Tube**—Hernia of the ovary and tube in children can sometimes be retained in the abdomen by a bandage or truss and

in a few instances this treatment has resulted in a cure. On account of the effects of pressure on the ovary and tube, the disturbances in circulation, the dangers of atrophy and the chance of cystic and malignant disease, operative treatment should always be advised.

Whenever possible, the ovary should be returned to the abdominal cavity because of the importance of its function as an endocrine gland. In true torsion of the ovary and tube, if gentle taxis is not successful, immediate operation is indicated on account of the danger of gangrene, which not infrequently follows expectant treatment. When a portion of the ovary is cystic, it can be partially resected. In the presence of suppuration, extensive cystic degeneration or neoplastic changes the ovary and tube must be removed.

**Hernia of the Uterus**—Hernia of the nonpregnant uterus should always be treated by reduction of the tumor and operative closure of the hernial opening, because of the serious complications that might ensue should pregnancy occur.

Hernia of the pregnant uterus should be reduced and retained by a firm bandage, or better still, a radical operation undertaken and the hernial opening closed. If the patient is seen for the first time, near term, and the hernia is irreducible, a hysterotomy, should be done, followed by hernioplasty at a later operation, as it is seldom possible to reduce the large uterus through the hernial ring until after involution has taken place.

Reyes observed that prolapse of the uterus is frequently accompanied by inguinal or femoral hernia. After doing a perineorrhaphy, and before repairing the hernia, he suspends the uterus by suturing it to the round ligaments.

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## CHAPTER XXXVI

### HERNIA INTO THE BROAD LIGAMENT

**Synonyms**—Broad ligament hernia, hernia of the broad ligament

**Definition**—A protrusion of abdominal viscera into an adventitious or postoperative pouch or aperture in the broad ligament

I believe that "*hernia into the broad ligament*" more accurately describes this type of hernia than other terms that have been used, on occasion, by some writers

#### Historical

The first case of hernia into the broad ligament was reported by Quain, in 1861. He reported the case of a woman who had died, without an operation with obscure symptoms of intestinal obstruction. At autopsy Quain found a strangulated hernia into the right broad ligament. Eve, in 1885, mentions the possibility of hernia occurring into the broad ligament, but like other internal hernias, the subject received scant attention, even with the publication of Moynihan's monograph on retroperitoneal hernia in 1906.

Interest was revived by Fagge, in 1917, who reported 2 cases of hernia into abnormal openings in the broad ligament, along with an excellent description of the anatomy of this region and observations on the etiology. This was followed by case reports and papers on hernia into the broad ligament, by Barr, in 1920, Dunn, in 1926, James in 1929, Caplan in 1930, Duncan and Shera in 1930, Cooper, in 1931, Gray and Bailhe in 1933, Hamilton and Knight, in 1934, Hunt, in 1934, Bowles, in 1939, Koch, in 1941, Pravia, in 1942, Armstrong, in 1944, Goode and Newbern, in 1944, and other surgeons.

Bowles, as well as Goode and Newbern, published excellent reviews of the reported cases of hernia through adventitious openings in the broad ligament. Shepard and Waugh, in 1942 reported a very rare case of hernia into the suspensory ligament of the ovary.

Hernia into the broad ligament through an anomalous opening usually occurs in women between twenty and fifty years of age often in those who have one or more children.

**Hernia Complicating Suspension or Fixation of Uterus**—Strictly speaking, hernias in this group are postoperative hernias or complications and have little relation to primary hernias into the broad ligament. Because of the fact that writers mix the two groups indiscriminately, it is advisable to consider them here.

Naturally, most of the reported cases of hernia into the broad ligament are, in reality, postoperative hernias developing in women who have had operations for ventrofixation of the uterus or shortening of the round ligament. The Doléris, Gilliam, Graves, Olshausen, Simpson, Webster Baldy operations have

all been complicated by postoperative intestinal strangulation Gariepy, in 1947, reported three cases

There is no doubt but that this complication is more common than statistics show, because many surgeons are reluctant to report their bad results in abdominal surgery Anyway, soon after suspension operations of the uterus reached the height of their popularity, reports began to appear in the literature of intestinal strangulation as a complication It may occur anytime, from a week to several years after the original operation

Important papers were published by Michael, in 1936, Bolo, in 1937, Bowles, in 1939, Leger, in 1942, Pierini, in 1942, and Armstrong, in 1944, reviewed the literature Pulrang, in 1944 collected the reported cases and suggested an operative procedure to prevent this complication

### Statistics

Statistics are confusing as many writers insist on combining their discussions on hernia into the broad ligament through a fenestra or into a pouch in the ligament with postoperative hernias complicating an operation Hernias through an abnormal or congenital opening are very rare, while postoperative hernias are more frequent Statistics are not complete, for instance, Leger states he found 19 cases in the literature but does not give references Goode and Newbern found 27 cases in the literature and reported one case of their own of true broad ligament hernia, 9 of these hernias were complications of the Webster-Baldy operation Pulrang, in 1944 was able to find 15 postoperative hernias into the broad ligament in the literature, including one of his own

### Anatomy

The broad ligament is generally described as being divided into a small upper triangle and a larger lower triangle by the ligamentum ovarium proprium. The upper triangle, the mesosalpinx, is bounded on the inner side by the uterus, above by the fallopian tube, below by the ovarian ligament, and on the outer side by the ovary The lower triangle is bound by the uterus on the inner side, above by the ovarian ligament, on the outer side by the suspensory ligament of the ovary, and below by the pelvic fascia

**The Preformed Pouch or Opening in the Broad Ligament**—The size of the congenital or abnormal opening in the broad ligament is variable and may be  $\frac{1}{2}$  to 2 inches (1.25 to 5 cm) in diameter Pouches always occur below the ovarian ligament, near the uterus

Either triangle may be the site of a hernia, but there must be a preformed pouch or an adventitious opening in the broad ligament Thus, of course, does not apply to strangulation of the intestine as a postoperative complication following ventrofixation or round ligament suspension

### Etiology

There is no embryologic explanation for these hernias Naturally, an abnormal opening or fenestra is the prime requisite for a hernia into the broad ligament (Fig 262)

Many theories have been advanced as the cause of true hernia into the broad ligament. Since most of the cases have been in multiparas Pidecof believed that the enlargement of the gravid uterus during pregnancy or its sudden collapse after delivery could produce such a rent or hole. Jones has suggested that the trauma as the result of torsion and traction on the uterus during a cesarean section might also be a factor.

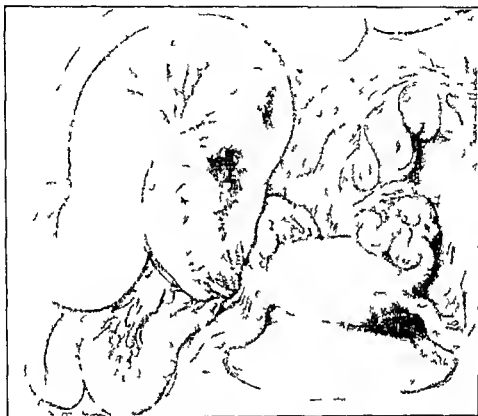


Fig. 26\*—Hernia into the broad ligament.

*Other theories that have been advanced include* congenital anomalies in uterine lacerations due to pregnancy and labor anatomic defects the result of previous infections and inflammatory processes adhesions peritonitis etc.

*Exciting causes include* straining especially at stool a fall a sudden increase in intestinal pressure an injury or blow on the lower abdomen in the region of the uterus.

#### **Symptoms and Diagnosis**

In the reported cases a preoperative diagnosis was not made. As a rule the symptoms were out of proportion to the apparent abdominal condition. The symptoms are those of intestinal obstruction or strangulation. Jones stated that definite tenderness on moving the uterus and in the fornix or pouch of Douglas in the presence of intestinal obstruction should suggest a possible diagnosis of strangulated hernia into the broad ligament.

On the other hand, if the patient gives a history of ventrosuspension of the uterus, or shortening of the round ligaments, a diagnosis of strangulated hernia is very probable. In any case, an exploratory laparotomy should be carried out without delay.

### Prognosis

The prognosis is favorable with early operation. Delayed intervention is serious. In 19 cases of postoperative strangulation following suspension of the uterus, collected by Leger, there were 6 deaths.

### Treatment

Operation is the only treatment for hernia into the broad ligament. Almost always, the patient comes as an emergency case. For this reason, spinal anesthesia is usually the anesthetic of choice and is also the safest due to the critical condition of the patient.

After reducing and treating the strangulated intestine, omentum, or other viscus involved, close the opening in the broad ligament with sutures, after first peritonizing the raw edges of the opening, as emphasized by Pullrang.

If the patient is elderly, it is often advisable to excise the tube and ovary on the affected side as assurance that the hernia will not recur.

Michael advises that, when operating for ventral round ligament fixation, the space between the distal portion of the round ligament and the abdominal wall be obliterated by suturing the two structures together, so as to prevent a postoperative hernia at this site.

I have observed that, in performing the Webster-Baldy operation, if the round ligaments are brought too far from the utero-ovarian ligament, there is danger of an opening being torn in the broad ligament, even if the broad ligament is sutured to the round ligament. Thus error in technique may be responsible for a hernia in later years.

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## CHAPTER XXXVII

### THE TRUSS TREATMENT OF HERNIA

Small hernias in infants and in children up to four years of age can some times be cured by a truss. After this age the truss is merely a palliative measure and operation is to be recommended for all hernias except the massive irreducible ones that have lost their *right of domicile* in the abdominal cavity and those in which the hernial opening is so large that there is little prospect of closing it securely. Palliative treatment may be necessary for exceptional patients whose condition does not warrant radical operation even with local anæsthesia.

**Mechanical Treatment of Inguinal Hernia**—Bandage treatment dates from ancient times being associated with the earliest references to hernia and probably represents the first attempt to relieve this affliction. According to Poncet it was used in 900 B C and Celsus described a girdle that was worn around the pelvis and fastened to a pad that compressed the hernia. The iron truss was introduced in 1306 by Gordon and Gatinaria stated that trusses with an iron pad and circle were made in Italy at the end of the fifteenth century. The steel truss was first used in France by LeQun in 1628 and Blakey introduced it into England in 1783.

The English cross body truss introduced in 1806 was devised for small easily reducible hernia. The spring is complete in front and beginning at the pad over the inguinal canal it passes across the pubis from the affected side to the sound side and continues three fourths of the way around the pelvis to the buttock of the affected side. The pressure of the pad is inward and upward.

I believe that at least 7 per cent of truss wearing patients are improperly fitted with a pad that is too small because the patient wants a truss that does not show through the clothing.

**Diagnosis**—The average truss fitter as well as many physicians does not make a diagnosis beforehand. It is most important to distinguish between a direct and an indirect inguinal hernia.

**Fit of Truss**—A majority of trusses do not fit tight enough to hold the hernia securely within the abdomen at all times during exercise and while at work. A loose truss has a tendency to make pressure over or below the external inguinal ring instead of over the inguinal canal or Hesselbach's triangle where it will do the most good.

When the cushion pad is too low there is a tendency for the hernia to bulge above the pad and separate the muscles and fascia on the upper edge of the hernial ring.

The pad must be large enough to cover the hernial opening completely. Applying a pad that is too small is a common fault of truss fitting and is often

the result of the patient's insistence on a small pad that will not show through his clothing. Women are particularly hard to please because their clothing is already tight fitting.

I prefer to start with a large pad and reduce the size of the cushion as the hernia improves.

**Types of Trusses**—As a rule, the most comfortable truss is one with a semielastic body band and a large thick molded soft rubber cushion pad that fits over the pubic bone and holds the hernia inside the inguinal canal. The cushion is 2 inches (5 cm) thick over the hernial opening and only 1 inch (2.5 cm) thick where it fits over the pubic bone. The pads come in several sizes to fit any hernia. It is always necessary to wear a snug fitting thigh strap to hold the lower end of the cushion pad down close to the pubic ramus.



Fig 263A



Fig 263B

Fig 263A—Spring aluminum one-piece cross body truss (Benjamin)

Fig 263B—Spring aluminum leather covered double truss (Benjamin)

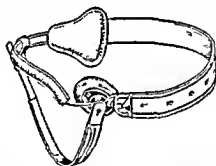


Fig 264.—An efficient spring type truss with soft rubber hernial pad and single back pad. (Courtesy of Ohio Truss Co Cincinnati Ohio)



Fig 265—Cross body frame truss for femoral hernia (Pomeroy)

Some patients who are very active are more comfortable with a spring type truss. The spring is fitted on the side of the hernia only, and a leather band goes around the sound side, a thigh strap may be necessary to keep the truss from slipping. This truss does not loosen when the thighs move forward in stooping and lifting as the band type truss does. The latter truss is usually necessary for bilateral hernia. Whether the patient will be more comfortable with a spring, elastic, or frame truss depends largely on the skill of the fitter.



The English rat tail truss does not give sufficient retention, and the old style spring truss is equally ineffective (Figs 263A, 263B, 264, and 265)

The pad of the truss should fit correctly over the inguinal canal and not over the external ring. In the latter position, the hernia may slip by the truss, and the pressure on the spermatic cord as it passes over the pubic bone is painful. To prevent pressure on the cord, an oscillating pad should be used and the frame should be angled to give more tilting to the pad.

**Percentage of Cures With Truss**—Spanton stated that in a total of 96,886 patients treated by trusses at the London Truss Society, only 4,387, or 4.53 per cent, were cured.

While small hernias in infants may disappear with truss treatment, there is a decided tendency to use other measures that produce a quicker cure, even in young infants. Coley (W B) stated that 50 per cent could be cured with a truss, De Garmo claimed 75 per cent, while Ochsner (A J) estimated cures at 95 per cent. There is no question that in many apparent cures with a truss the sac is only incompletely obliterated, and this explains why a high percentage have a recurrence in later life.

Coyte states that umbilical hernia is very common in newborn infants among the black races of South Africa, and while the condition is seldom treated in any way, these hernias tend to disappear in the majority of cases, however, in the white races the condition usually persists into adult life in spite of truss treatment.

**Fitting the Truss**—Truss fitting is a science, a specialty in itself. For the best results the services of a skilled appliance specialist should always be secured, he knows the requisites of a truss and wherein they differ from the stock and mail order varieties. He has a large selection of trusses of every type and size, and the mechanical equipment with which to mold, angle and shape the appliance to the body contour of the patient.

The physician can fit the truss if he feels competent to do so. It is necessary for him to know how to select the appropriate type, and to tell whether or not the hernia is being held completely reduced at all times. The truss must be fitted so it will not move under any strain or test such as coughing, sneezing, stooping, bending, or turning over in bed.

One inexperienced in truss fitting usually sets the truss too low, so that the pad is over the external inguinal ring. Even if the truss is comfortable in this position, it is ineffective.

For the direct inguinal hernia the truss pad fits over the upper part of the external ring and down close to the pubis. It is usually necessary for the pad to reach the edge of the rectus muscle in order to cover the hernial opening.

In indirect hernia the pad must fit squarely over the internal ring and the walls of the entire inguinal canal must be kept approximated constantly.

**Measuring for the Truss**—With the patient in the recumbent position, the measuring tape should be passed around the pelvis at the level of the internal rings, midway between the crest of the ilium and the great trochanter. The tape follows the obliquity of the pelvis which is lower in front than in the back. The

distance between the inguinal canals should also be measured, as the pad must be closer together for direct than for indirect hernia

A diagram made with lead tape is valuable. A strip of this tape about  $\frac{1}{2}$  inch (1.25 cm) wide,  $\frac{1}{16}$  inch (2 mm) thick, and about 20 inches (50 cm) long is used. Beginning at the median line just above the symphysis pubis, the tape is passed over the sound side, around the abdomen, over the hip on the opposite side and across the back. The lead is pressed to the form of the body and care fully removed, placed on a sheet of paper and a tracing made of its inner surface. The process is repeated for the opposite side. This procedure will give a diagram of the figure as well as the circumference of the body. With this diagram as a guide, the instrument maker can fashion an accurately fitting truss.

**Mechanical Treatment in Infants and Children**—The best results from truss treatment are secured in children under four years of age. Some are cured up to five years, and a few up to ten years. After this age, cure by truss is very rare. Hernia in infants is not accompanied by the difficulties encountered in adults, as it is almost always small, reducible and easily retained.

In children under four years of age cure by means of a truss may be attempted before operation is resorted to. The truss should be applied as soon as possible after diagnosis. An infant a few days old is not too young to wear a truss. The elastic type is the best and it must be made very light. In the event of a cold, whooping cough, or bronchitis the truss should be temporarily strengthened.

It is usually necessary for the child to wear the truss continuously, day and night, for at least a year, to effect a cure. As the hernial ring diminishes in size, the truss should be adjusted. The child's skin must always be kept scrupulously clean and dry. The truss should be removed once a day for bathing, which should be done with the child lying as quiet as possible. If the hernia shows any tendency to protrude, the nurse or mother should place her finger over the ring until the truss can be reapplied.

The diet should be regulated to overcome any tendency to constipation, flatulence, or too rapid a gain in weight. As the child grows it is necessary to adjust the truss from time to time, and for this reason the physician should see his little patient at least twice a month.

At the present time, the most generally used truss is of the frame type, and it should be made of material that can be shaped in such a way that it fits into every curve and line in the circumference of the body without making undue pressure at any one point.

Different gauges are used, the heavier ones being required for patients with marked intraabdominal tension, and the lighter ones for those with only slight intraabdominal pressure.

The size of the pad that is required to control the hernia must be determined by individual needs. The pad may be covered with a gum pouch, soft silk, or velvetene plush.

Objection is sometimes made to the use of leather and fabric on the body, but if the truss and pad are kept clean and the body is scrupulously cared for, these soft materials are more comfortable than hard rubber and celluloid cover.

ings If the patient is to wear a truss constantly, it must be comfortable I make it a point to see that the pad and truss coverings are changed at least twice a year

**Difficulties of Truss Treatment in Direct Hernia**—In direct inguinal hernia, truss treatment is unsatisfactory because the hernial opening is close to the pubic bone, passing directly back into the abdomen and the hernial contents are difficult to retain

**Uses and Limitations of the Truss in Adults**—Small hernias can some times be controlled with a truss I or those patients who refuse operation palliative treatment is necessary to keep the hernia from becoming large and uncontrollable

Every patient who wears a truss and believes it is properly fitted knows that it is only a makeshift that it will not cure his hernia, and that there is danger of strangulation at any time should the truss slip while he is engaged in active exercise He also knows that if his hernia increases in size as many do he will have to seek further treatment and it is at this stage that many patients become easy prey for the charlatan or quack

**Discomfort Caused by the Truss**—The irritation annoyance and physical discomfort caused by the truss are very pronounced especially during the summer months and at times are sufficiently serious to impair the health Patients often remark that they were unable to do a full day's work until the hernia was cured by the injection treatment or operation A number of patients supposed to have been cured by a truss in infancy have a return of their trouble in adolescence or early manhood If the pressure of the truss has been firm peritoneal adhesions form and a gradual decrease in the size of the abdominal opening usually results

**Contraindications to Mechanical Treatment**—The following conditions may interfere with the fitting of a truss and with the successful retention of a hernia hydrocele cysts of the cord or in the canal of Nuck varicocele ectopia testis ovary in the hernial sac pregnancy, adhesions of hernial contents to each other or to the sac wall and interstitial hernia

On account of the danger of strangulation irreducible hernia is not suited to truss treatment and the radical operation should be done

**The Point of Pressure on the Sac by the Truss**—The chief disadvantage of truss treatment is that the pad of the truss makes pressure on the sac in the inguinal canal and if obliteration occurs from the irritation of the pressure it takes place below and not at the internal ring This is probably the reason that so many hernias apparently cured by a truss recur in later life

**Rules for Truss Wearing**—The adult patient should remove his truss after he is in bed and put it on before arising in the morning The truss must always be worn next to the body It is dangerous to wear it over the underwear and it should be removed while taking a bath A patient accustomed to a truss should never walk or stand without it because if the hernia should come down the danger of strangulation is greater than if he had never worn a truss When the patient has a cough or if the hernia is very large he should wear a light

weight elastic truss at night. If the hernia becomes painful or irreducible, the physician should immediately examine it for possible incarceration or strangulation. The irritation caused by the truss can be lessened if the parts are bathed daily, and a dusting powder, such as zinc stearate or talcum, is used freely. The truss should be kept clean by washing it in water. A gain in weight should be guarded against.

**Umbilical Hernia**—For large umbilical hernia a steel spring truss is the best. It should be covered with leather or a soft material to prevent rubbing of the skin. The snap or fastening should be on the outer surface of the plate holding the hernia pad. If the patient is obese, it is advisable to use an abdominal support with the umbilical pad built into the belt. It is often advisable to place a small pad that fits into the hernial opening on the inside of the large pad that covers the hernia. (Figs 266, 267 and 268.)

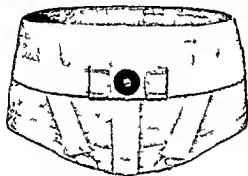


Fig 266

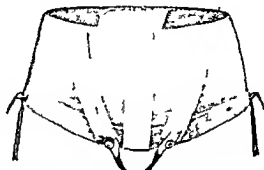


Fig 267

Fig 266.—Elastic abdominal supporter fitted with umbilical hernia pad (Pomeroy)

Fig 267.—Elastic abdominal supporter for obesity (Pomeroy)

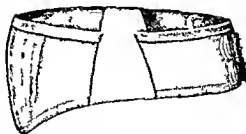


Fig 268.—Elastic abdominal supporter (Pomeroy)

Coyte suggests that the belt be fitted in place with the patient lying down and the head lower than the pelvis. Thus causes the abdominal viscera to fall back into the abdomen where they exert no pressure on the anterior abdominal wall.

**Hernias Impossible to Control With a Truss**—Large hernias with external rings 3 cm. in diameter, or smaller, that cannot be held by a properly fitted truss require special treatment. Occasionally, such hernias are encountered in thin persons, but as a rule they are found in the obese. The patient is usually elderly, with poor musculature, a large pendulous abdomen and rolls

of soft, flabby fat that dislocate the truss pad when he walks, stoops, strains, or attempts to carry on the activities of his daily life. The routine treatment is as follows:

**Diet**—A balanced diet is calculated to reduce his weight by 2 to 5 pounds a week. This means he receives from 1,000 to 1,500 calories daily, depending on his general health, the physical exercise he takes and the amount of work he must carry on. This routine should be followed for two to six weeks, and every few days the truss should be readjusted and tightened to suit his loss of weight.

**Hospitalization and Treatment**—When sufficient weight has been lost, the patient is put to bed in a hospital, and the foot of the bed is elevated 6 to 12 inches. In this position the hernia reduces spontaneously and can easily be retained by a light truss which must be worn day and night.

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## CHAPTER XXXVIII

### INJECTION TREATMENT OF HERNIA

The following chapters devoted to the injection method are prepared with a desire to present practical information easily accessible, without more repetition than necessary, to aid the busy surgeon in obtaining good results from a treatment that has much to commend it, for small hernias in private patients and those not doing heavy manual labor. It should not be used for the average clinic patient.

It is not possible for many of us to leave our practices to study new trends in old procedures as they develop or even to take many hours out of our daily program for the purpose. Those to whom the injection method is new probably have definite questions in mind, these I have endeavored to anticipate and answer, using past experience as a guide when my own queries have run some thing like this: What are the results of this treatment? What are the dangers to consider? How are suitable patients selected?

The technique will be found described step by step. Careful study has been given to the injection fluids, testing the many mixtures from every angle and observing their action immediate and remote. It will be noticed that in this work clinical experience takes precedence over experimental observations—practical results always being more impressive and helpful than theories to the busy physician and surgeon.

From a surgical standpoint it is most convenient to consider the injection treatment with inguinal hernia because it is in this variety that the general surgeon will find the greatest field of usefulness for the injection method, as on adjunct to surgical operation.

The Surgeon General of the United States Army announced on April 23, 1942, the following policies of his office concerning recommendations for waiver for limited service officers:

"2. The following may be recommended for general military service with waiver:  
g. History of operation or of injection treatment for inguinal or small ventral hernia, provided examination three months or more following operation, or following the last injection, shows a satisfactory result."

**Vitamins That Aid the Injection Treatment**—Securing the best results with the injection, as with the operation, calls for special attention to the patient's general health. I make it a routine to administer large doses of vitamin C and vitamin B complex during treatment and for a period afterward. A low ascorbic acid level calls for a week's preoperative treatment with daily doses of 1,000 mg. of ascorbic acid, vitamin B complex, preferably intravenously or intramuscularly, iron for a low blood count, and a high caloric diet of proteins, fats, carbohydrates, and fluids.

## HISTORICAL

Both the operation and the injection method developed from the maze of treatments used through the early and middle centuries for the relief of hernia, such simple instinctive aids included the application of warm and cool water over the tumor, massage, exercise diet and bandaging. While some of these palliative measures were properly carried out, judged even by today's standards they represented the best knowledge in this direction until almost the beginning of the eighteenth century. As education increased physicians became more confident although anesthesia and antiseptics were unknown.

It was believed that to cure hernia sufficient irritation must be produced to close the hernial opening great care being taken not to puncture the peritoneal cavity or sac because that meant sudden death. Various methods considered safe were used to produce this irritation a trocar was passed along the inguinal canal to the inguinal ring to traumatize the edges of the ring a needle or wire was introduced into the margin of the internal ring to irritate the muscle fibers caustic or strong irritants were applied to the tumor with pads or poultices and trusses with rigid pads were placed over the internal ring.

The next logical step was an attempt to destroy the sac by means of escharotics accordingly, George Heaton of Alton Illinois injected fluid into the tissue of the hernial region. Heaton was graduated from Dartmouth Medical College in 1831 and he moved to Boston to practice his profession in 1842. During this interim of approximately eight years he used the injection method extensively experimenting with the essential oils and iodine as injection substances but finally adopted fluid extract of white oak as his choice.

With his theories and claims supported by case histories and many cured patients he is said to have invited the representatives of the medical profession in Boston to see him perform the injection. Just how much of his technique he intended to disclose will never be known because his invitation was declined as an impudence and was never repeated in this country. This made something of a martyr of Heaton the press advocated his cause directed public sentiment in his favor thus advertising his ability to the extent that in a comparatively short time he reaped a small fortune.

Having once been refused a reception with the members of his profession he continued to keep secret both his technique and his solutions. The incident was unfortunate from beginning to end because whatever his ethics however crude his equipment and surgical skill medical writers seem to agree that the facts of the issue converged to show that Heaton actually cured more patients of reducible hernia by means of the injection method than had been cured by all other methods combined up to this time. The most regrettable aspect of the affair is that through a misunderstanding and natural conservatism the medical profession failed to claim a new surgical principle of great value. Rejected by the only group capable of sponsoring and developing it the irregular practitioners grasped it satisfied that their qualifications would go unchallenged by the medical profession and would be regarded more leniently by the public owing to the popularity of the treatment attained through brilliant results.

About 1845 Heaton visited London where he was made a member of the Royal Chirurgical, and the Westminster and London Societies. He was similarly honored on the Continent, particularly in Paris. This recognition is partially accounted for by the fact that the injection method was adopted earlier in Europe and more generally used than in the United States. Professor Joseph Pancoast of Philadelphia was probably the first American surgeon of prominence to use it. As early as 1836 he used tr. iodin or tr. cantharides solutions and obtained good results with these strong agents. Many years later, in 1851, John Watson of New York described and used similar solutions.

Velpeau, of Paris, treated his first patient in 1835, in 1846 his *Thésis de Paris* was published and contained a description of his method, briefly as follows. He opened the neck of the sac and while an assistant compressed the inguinal canal to prevent the fluid entering the abdominal cavity, injected a mixture of 6 drams of tr. iodin in 3 ounces of water and forced it into all parts of the sac. No untoward symptoms followed, but the treatment failed in its purpose, so Velpeau abandoned it for hernia, continuing to employ the fluid for hydrocele successfully.

The injection method was used extensively in Paris in the 50's by physicians and surgeons of prominence, among whom were Demeaux, Johert, Maisonneuve, Nélaton and Ricord. The drugs and chemicals employed as solutions were legion, differing widely in many respects, they were used singly and in every conceivable combination. The following were tried and discarded one after the other: blood, tobacco, ammonia, essential oils, olive and linseed oils, zinc salts, tr. cantharides, tr. iodin, tr. veratrum viride, morphine sulphate, ether, chloroform, pinus canadensis and ext. of white oak bark (*quercus alba*), this last named was Heaton's favorite solution and the mildest of all the substances used at this time. His good results were partly due to the tannic acid ingredient in the white oak. During the 60's and 70's the total amount of work done throughout the world with the injection method was so small that progress was at a standstill with the trend toward the operation. Heaton enjoyed a large and lucrative practice in Boston continually at odds with the members of his profession but well thought of by the public. His monograph on the cure of hernia appeared in 1877, two years before he died. The reviewers simply dismissed it without serious investigation or comment rather than with criticism, and it is only in the last few years that it has taken its proper place as a reference work.

Schwalbe, in Germany, in 1875 recommended using an injection solution of alcohol in various strengths, finally adopting a 70 per cent solution as his choice. Of the comparatively few physicians and surgeons who advocated Heaton's method and carried on the treatment after his death Professor Joseph H. Warren is the most widely known. In his *Surgery*, published in 1881, he described an improved syringe and needle for the injection of hernia and stated that he did not inject into the sac but "into the rings and around the sac," much as we do today. He also added morphine to the white oak bark solution. The good results he reported in his book gave new impetus to the injection



method, short lived, however, as it was soon to be all but abandoned in favor of the operation, which attained its height of popularity during the next two decades

The evolution of the treatment for hernia is closely associated with the discovery of antiseptics by Lister. Marey studied under Lister in Edinburgh. Shortly afterward he perfected the absorbable suture for closing the hernial wound, and advised high ligation of the sac and reconstruction of the canal just as we do it today

Marey described this epoch making technique in a paper he read before the International Medical Congress in London in 1881, which revolutionized the treatment of hernia and eclipsed the countless methods that had been used, including the injection treatment, considered of more or less questionable value at that time

Besides Marey and Bassini, MacEwen, Halsted and many others developed new surgical techniques that gave results so far surpassing those heretofore obtained that a general wave of enthusiasm for them consigned the injection method to oblivion for many years, and it might never have been resurrected but for one reason, and that was the problem of recurrence

With this large number of highly developed operative procedures from which to select the most suitable technique for each operation, the percentage of recurrence still remained too high in all varieties except the small indirect inguinal type. Because of this, and the natural aversion most people have to an operation—not to mention the loss of time from employment and the accompanying hospital expense—the injection method has been revived and developed to the end that many more of the herniated may avail themselves of a treatment less complicated than operation, less expensive, and offering an equal assurance of cure. Clarke of London, in his *Manual of Surgery* published in 1879, observed that the injection method had the merit of simplicity

Owing to the variation in technique and solutions, space forbids elaborate description of records, but for the sake of completeness and to show that continued effort was carried on in different parts of the world, certain references will be mentioned briefly

In 1891 Steffen reported the records of 1,372 patients treated in his clinic in Switzerland, of this number 66 per cent were found cured at the end of the first year. Ignatz Mayer of Detroit began using the method in 1894, injecting a phenol and zinc sulphate solution. In 1927 he claimed a high percentage of cures in 2,000 patients. McDonald began using the treatment in the late 90's and in 1905 reported a large number of patients permanently cured. In 1908 Wollerman of Germany, reported 544 patients treated since 1891, with 92 per cent cured. In 1929 he reported the records of 2,949 patients treated over a period of twenty five years, with 94 per cent cured

Mestre of Barcelona began an intensive study of the injection method about 1916 and ten years later reported many patients cured, with a semisecret formula. In 1929 Wyss of Switzerland reported an account of the results obtained from an exhaustive study carried on at the Steffen Clinic. Over a period

of thirty years 4,632 patients were treated with injections of alcohol solution, of these, 3,048 were followed up, and showed 91 per cent cured. Of the hernias cured, 2,775 were inguinal, and 309 included femoral, umbilical and ventral.

Thanks to the tireless experiments of the clinicians and laboratory research workers who have carried on despite early criticism, the logical principles of the injection method have been placed in scientific hands.

## INDICATIONS AND ECONOMIC ADVANTAGES

### Indications

Of the individuals in need of treatment for inguinal hernia who do no heavy manual labor, there is a group for whom operation is indicated, or operation combined with the injection method or mechanical treatment alone. The total number of these patients is small, and owing to the nature of the respective procedures of treatment such groups are not considered here.

There remains that large group of private patients well suited in every particular to the injection method or to the operation for the cure of their hernias, and, all things being equal, the choice of methods is optional with them. They constitute a majority of the patients in private practice, thus affording the best means of considering the indications and advantages of the injection method from an economic standpoint.

There is almost no mortality from the injection treatment as it is used today. Reports in the literature of mortality ascribed to this treatment, when only the dangerous solutions were used, do not in any respect apply to the modern technique.

**Prevention of Pain**—The comfort of the patient is the first consideration. The injection must be painless, and it is when the proper technique is carried out. Painlessness depends mainly on two things—the choice of solution and the method of administering it. If the patient is to take his treatments regularly he must be assured and certain he will not be hurt, otherwise he will avoid the injections and a cure will not be effected. I know of many failures due to the simple fact that patients could not stand the pain which was caused only by too strong solutions, and they stopped treatment.

Confident that the injection is painless patients do not dread it. I have many who come to the office to take an injection during their lunch hour, returning to work almost immediately, others take it when their work is finished for the day and they are on their way home, facing a long streetcar ride or driving their own car. It does not interrupt routine. People past the active years do not complain, and I have been surprised that children take it so nicely.

Because the method is ambulatory, practically painless, and no general anesthetic is necessary, a cure is available for many people who otherwise would never attempt it. The danger of postoperative pneumonia and embolism is removed, and other complications that are always serious for the type of patients mentioned below, because, if for no other reason, the length

of time in bed may be extended. Also the injection method eliminates the shock after operation hazardous for these patients as well as for the precarious convalescent.

1 Invalids, and frail and debilitated patients

2 Those individuals afflicted to a mild degree with a serious ailment independent of the hernia

3 Those at the extremes of life

**Patients Who Refuse Operation**—The injection method is complementary to the operation for hernia and is not competitive in that large group of patients who refuse the radical operation. An increasing number of women with small reducible hernias who have always refused radical operation will accept the injection method.

### Economic Advantages

There was a time when the patient regarded the treatment of his hernia as something that could be neglected until a convenient time, the necessity for cure often seeming to diminish with the passing years. Now the situation is reversed. Owing to increasingly rigid physical examinations demanded by employers, the cure of his hernia is the one thing that cannot be neglected because his success in securing employment and holding it may depend on this one condition.

1 **The Patient**—A well to do man is often as pleased by the saving in hospital expense as the man of moderate means and he is as reluctant to give up his business and usual activities while confined to the hospital, as the employee is apprehensive concerning his work while he is in bed.

In whatever financial situation they may be, all are glad to avoid the risk and anxiety of the anesthetic and operation, a point emphasized so often that I must observe that patients could not have been so satisfied with the operation as we believed them to be.

2 **The Employee**—The injection treatment appeals particularly to the employee because he can have his hernia cured without time from work, loss of wages, and the expense of hospitalization. There are two expenses of treatment, and they can be definitely determined before hand—the surgeon's fee and the truss.

The man past forty, in the same employment for many years, probably was not examined when he secured his position. If he was examined and had a hernia then perhaps it was small and the medical examiner did not notice it. Now the employee knows that sooner or later he will have to face a physical examination at the request of his present employer or a new one. There may be reasons why he does not want the existence of his hernia known, in such circumstances the ambulatory treatment offers the solution.

The industrial worker who has to do heavy manual labor while taking treatment is not suitable for the injection method, except in certain instances. The principal reason is that the insurance carrier insists that he take no time off from work to rest.

### Results Following the Injection Treatment

In more than 20,000 injections, I have had only 4 serious complications irreducibility following injection of the internal ring with strong tannic acid and chemical preparations. These patients were operated on and made uneventful recoveries. For this reason, I abandoned, some four years ago, all types of strong irritating solutions, and I now use only the nonirritating procaine-quinine phenol solution for adults, and the one half strength solution for infants and children. For a similar reason I discontinued the use of oily solutions, occasionally, a patient would have a mild attack of coughing, which I attributed to some of the solution finding its way into the blood stream in spite of the usual precautions to avoid entering a blood vessel with the needle. Since changing to the mild procaine quinine phenol solution, this accident has not occurred. Such emergencies, however, are always to be borne in mind, if we are constantly on the alert and are prepared, we shall seldom be called on to meet them.

The fact remains that there have been no deaths, and complications have been much lower than with operative treatment, especially since most of my patients are middle aged or elderly.

Because of the fact that 75 per cent of patients treated by the injection method are between fifty and eighty years of age, it is impossible to make an accurate comparison of the recurrence rate with that following operation. Nearly all of the statistical tables of postoperative recurrence are made up of adults twenty to fifty years of age.

In a series of 1,000 private patients, small indirect inguinal hernias gave 90 per cent of cures, small direct and recurrent hernias, 85 per cent. Large indirect and direct hernias, as well as those industrial hernias in patients compelled to do heavy manual labor, are not suited to the injection method of treatment.

### Recurrence Following the Operation

In 1937, Burdick, Gillespie, and Higinbotham reported the results following fascial suture operations at the Hospital for Special Surgery, New York. Fascial sutures were used for direct inguinal hernias, combined direct and indirect inguinal, large scrotal, all recurrent hernias and all ventral hernias including the umbilical and the epigastric types. In 1485 operations on 1,092 patients there were 25 operative deaths. The percentage of recurrence following the use of autogenous fascial sutures was 27.7 per cent, 28.3 per cent after homologous fascia, and 35.5 per cent recurrence followed the use of ox fascia sutures.

Grace and Johnson reported statistics from the Hospital for Special Surgery, New York, showing that in 1,032 patients fifty years of age and over, operated on for hernia, the mortality rate was 3 per cent. In primary inguinal hernias the recurrence rate was 25 per cent, and in the recurrent inguinal hernias 34 per cent recurred after operation.

Cowell, in his book, *Hernia and Hernioplasty*, stated that the average number of recurrences following operation is 3 to 8 per cent for indirect inguinal

hernia, 16 to 25 per cent for direct inguinal hernia, and 9 to 14 per cent for femoral hernia. L. Davis reported 1500 hernia operations at the Massachusetts General Hospital. Of these he traced 704 indirect and found 8 per cent recurred. Of 88 direct that he was able to trace 15 per cent returned. Erdman reported 313 direct hernia operations at the New York Hospital, with 52 recurrences (18 per cent). Dinner reported 214 per cent recurrences following the Bassini operation in difficult inguinal hernias.

Experienced surgeons have very few recurrences but this favorable percentage does not hold good with physicians not specially trained in hernia surgery. As DrCosta remarked most surgeons belittle recurrences. However the longer one observes hernia patients after difficult operations the lower the percentage of cures. One by one with the passing years they slip from the cured group. Most of those who come to me with recurrence state that their surgeon does not know of their relapse therefore that surgeon has these patients on his record as cured of their hernia. Nearly 15 per cent of my private patients have had one or more unsuccessful operations.

E. M. Stanton stated that patients who are operated on by experienced surgeons will show indirect recurrent hernias 5 per cent the first year and 1 per cent additional recurrence each year thereafter. Direct hernias traced over a five year period showed 20 per cent recurrences.

### SELECTION OF CASES

We have all seen many surgical procedures presented for the first time with more or less zeal and are familiar with the manner in which they are received by the profession and the laity. In my experience I have never known the rank and file of patients to be so ready to accept a so called new treatment as they are ready to accept the injection for hernia.

Invariably I explain that the injection treatment does not take the place of the operation but supplements it and is optional for a large number of patients. From the standpoint of prognosis I classify all patients into three groups as follows:

- 1 Favorable
- 2 Borderline
- 3 Unfavorable

It is amazing how the natural conservatism of the physician often causes him to condemn a method of which he has no direct knowledge. Perhaps this is the reason that so many surgeons refuse to use the new operations for hernia and still employ the old Bassini operation.

The following observations are based on practical rather than theoretical selections. Emphasis must be placed on the fact that the injection supplements but cannot displace the operation in certain types of hernia conditions and varieties. The successful injection of hernia undoubtedly requires more skill than does the operation. It is no field for the amateur. Statistics show that the best results are obtained by those most experienced in the method. There is no branch of surgery in which diagnosis is more difficult than in inguinal and

femoral hernia and it is on this point that success or failure of the injection treatment sometimes hinges. Once diagnosis is made the physician must bear in mind that no two hernias are alike each requires careful study and individual variations in treatment.

### Favorable Cases

The injection method is indicated as a rule for the following groups

1 Industrial patients with small reducible hernia especially those who do only light work

2 Aged and infirm patients for whom operation carries increased risk and hazard

3 Infants and children with small hernia for whom operation is unsatisfactory owing to difficulties of postoperative care

4 Patients with small reducible hernia who are fearful of an operation

5 Patients with hernias of moderate size with the external inguinal rings measuring less than 2 cm. in diameter

6 Moderately obese patients excessive obesity must be reduced before the hernia is treated because the fat prevents examination of the external rings

7 Patients whose hernias show a tendency to recur after operation. A few injections properly placed often overcome the weakness that might develop into a recurrence

8 Patients with small postoperative hernias usually require 10 or 12 injections for a cure

9 The injection is particularly suitable for small direct inguinal hernias because they have a higher postoperative recurrence than the indirect variety

10 Femoral hernia can be injected if the hernia can be reduced and kept reduced continuously during treatment (Fig. 269). Only mild solutions should be employed strong solutions being liable to produce incarceration and irreducibility if the hernia accidentally slips by the truss. For this reason most hernias should always be injected in a hospital by one experienced in the difficulties of treatment in this variety

11 Umbilical hernia if small and completely reducible can usually be cured by injection quicker than indirect or direct inguinal hernias (Fig. 270)

12 Epigastric and hypogastric hernias in the midline are suitable for injection if completely reducible. When there is a plug of fat at the opening it can usually be shrunk into a fibrous cord if injected and the hernial opening can be closed later by a series of similar injections

13 Small reducible postoperative ventral hernias. It must be ascertained that there is no intestine or omentum adherent to the sac or abdominal peritoneum along the edge of the hernial ring. The patient should be of good musculature and there should not be much separation of the muscle edges around the hernial ring. If these edges cannot be held in apposition by a firmly fitted belt or truss, the hernia should be operated on.

Patients with poor musculature especially if they are past fifty years of age often show thin places in the muscles and fascia that are not noticeable until the bulging of the hernia is removed by treatment. For the same reason

a cured patient often states that he has developed a hernia on the side supposed to be sound when the herniated side was being treated while as a matter of fact there was a potential hernia there all the time. These weak spots cannot possibly be called recurrences because they have never been treated.



Fig. 269—Small femoral hernia suitable for injection treatment.



Fig. 270—Small umbilical hernia suitable for injection treatment.

The obese patient is more difficult to cure than the thin subject because the adipose tissue causes a weakening and thinning of the muscles and the intraabdominal tension is high and makes the hernia difficult to hold even with a well fitting truss. These patients should be given a diet of about 1300 calories and must lose some weight each week during their treatment. They must be warned not to put on weight after the treatment is finished.

### Unfavorable Cases

The injection method is never indicated for the following groups

- 1 All irreducible hernias—strangulated incarcerated or obstructed—and those with intrasaccular adhesions of omentum intestine, or other viscera
- 2 Hernias complicated with cancer ascites abdominal tumor, or severe hemophilia
- 3 Large hernias with rings measuring more than 3 cm in diameter or those in which the edges of the hernial rings cannot be brought into apposition by a firm fitting truss
- 4 Sliding hernia, true traumatic hernia and those associated with undescended testis at the internal inguinal ring However, with the testis at the external ring injections given above will often force the testis downward
- 5 Large reducible hernias associated with poor musculature small inguinal rings and the mass difficult to retain with a truss
- 6 Small hernias with large rings
- 7 Hernias complicated by diabetes hyperthyroidism, tuberculosis, hypertension, prostatic hypertrophy urethral stricture and chronic cough

### Infants and Children

There is some diversity of opinion as to when operation should be undertaken in children, but the same is hardly true of the injection treatment mainly owing to the greater simplicity of all the features of treatment (Fig 271)

There is comparatively little operative treatment for hernia in infants and very young children reported in the entire literature because most of such treatment is of urgent character, and there is little opportunity for nonurgent treatment, as cooperation from the parents of an infant is too much to expect I have had good results with the injection method in infants two to ten months old At that age by either operation or the injection method the anesthetic has a part in the operation which is perhaps balanced in favor of the injection method by the simpler care compared to the incision

These small patients require about one fourth to one half of the amount of solution used for adults The injections should be given once or twice a week, as described under the technique for inguinal hernia injection

The needle should be short bevel and  $\frac{5}{8}$  inch long It should be remembered that in children the bladder lies higher than in adults and it should always be empty at the time of injection (Fig 272)

### The Elderly Patient

Elderly people suffer more pain and discomfort from their hernias than younger people do and the result is that most of them are semi invalids On account of their reduced vitality they complain most bitterly against the annoyance and irritation produced by the hernia and the truss Their working capacity is reduced 25 to 75 per cent, they cannot get sufficient exercise to



keep well and their strength is continually sapped by unexpected attacks of colicky pain and discomfort in the hernia. I have treated many patients between sixty five and eighty years of age by operation or by means of the injection method and I believe that in every instance the patient's health has been improved his life perhaps lengthened (Fig 273). There has been no mortality. My oldest patient was ninety two years old the youngest four weeks.



Fig 271—Before and after injection treatment of a right indirect inguinal hernia in a boy nine years old.



Fig 272—Method of injecting inguinal hernia in a child.

**The Truss**—The annoyance of the truss more than anything else causes the elderly patient to seek relief often against the wishes of his family. He knows the truss is only a makeshift, an uncomfortable thing at best. Applying it tires him; the warm months are intolerable, often causing skin irritations and he lives in daily fear that the hernia will strangulate, requiring an emergency

operation Yet it is amazing how many of these unfortunate victims come for treatment after having worn a truss for forty to sixty years

**Operation Under Local Anesthesia**—The disinclination to operate on the elderly is no doubt well founded in many instances but it is my opinion that these patients are often unnecessarily denied relief from hernia

Local anesthesia which is almost imperative for the radical operation in the aged minimizes the hazards of confinement to bed more than any other factor If this period of inactivity can be managed without complications convalescence is often surprisingly smooth



Fig 775—Before and after injection treatment of bilateral inguinal hernias in a man eighty years old

**Injection Treatment**—The injection method being ambulatory is particularly suited to the needs of the elderly provided the hernia can be completely retained by a truss There is less danger of postoperative complications and in case of recurrence which is more to be considered as the musculature is frail in these subjects the repair consisting of a few reinforcing injections is a comparatively simple problem If the injection method is carried out with mild solutions a proper technique and the aid of a well fitted truss it is an efficient treatment for the cure of a majority of reducible hernias and a safer procedure than the operation

When a patient wants to have his hernia injected I see no reason for discouraging him and assuming a pessimistic prognosis simply because he is old If there are no contraindications to the treatment and his health warrants it he is the best judge as to when his hernia and truss have become unendurable

If it is ever possible to lend the maximum moral support and courage, it should be done in behalf of these frail patients whose gratitude for the comforts denied them as long as the truss is a part of their daily lives, matches the extra attention they undoubtedly require

1 Mild solutions must be used to avoid the least possibility of producing sufficient reaction to cause the patient to spend a day in bed

2 The injection must be painless Some elderly patients cannot stand pain in the least degree

3 As a rule, older patients should be overtreated rather than under treated, because the injections produce less proliferation of fibrous tissue than in younger subjects

4 It should be constantly remembered that the aged patient's margin of safety is limited and must not be jeopardized He requires careful watching and more personal care than does the younger patient No matter how good the patient's condition, the surgeon can never relax his vigilance

## CONTRAINDICATIONS AND COMPLICATIONS

### Contraindications

Though there is a broad field for the injection treatment of hernia, there are definite contraindications that may be divided into two groups those that apply to the hernia specifically, such as variety, size and individual peculiarities, and those that relate to the condition of the health of the patient

1 The injection must not be considered for the treatment of strangulated, irreducible, incarcerated obstructed, and true traumatic hernias As soon as diagnosis is made in these conditions operation should be undertaken immediately, preferably under local anesthesia

Though not urgent, operation—not injection—is the treatment for sliding and bladder hernias, also large serotal hernias with widely dilated rings associated with poor musculature

It is a good policy not to inject small serotal hernias when the external inguinal ring measures more than 2 cm in diameter It is no greater hardship to wear a truss following the injection treatment than after an operation for a large hernia, and in the latter case the experienced surgeon nowadays insists that a truss or firm bandage be worn for twelve months Small hernias with external inguinal rings measuring somewhat more than 2 cm in diameter can often be cured by injection provided the subject has good musculature and the tissues surrounding the inguinal ring are firm Success in such difficult cases depends largely upon the *skill* and the *patience* of the operator

Any variety of hernia complicated by intestinal or omental adhesions, tumors, undescended testes, abdominal or pelvic viscera in the sac, requires operation

2 The degree of comfort that an individual will enjoy from the cure of his hernia, by means of either the operation or the injection, depends to a great extent on his general health, which should be looked into at the time he presents

himself. There are those countless individuals suffering from one of several serious ailments that in itself would prohibit hernia treatment but for the fact that proper routine therapy is being administered for the ailment, and the patient is making some progress with prospect of permanent improvement or cure. Thus patients suffering from diabetes that is responding to insulin can at the same time take hernia injections. Patients under treatment for syphilis can take the injections for hernia. Particular care must be given to the boiling of syringes and needles after using.

For patients suffering with hyperthyroidism, nephritis, tuberculosis, prostatic hypertrophy with urinary retention, heart disease, urethral strictures, and chronic cough, the question of injections for hernia depends simply on the severity of the ailment. If it is moderate, and better still is responding to treatment, the injection for hernia is indicated and the cure of the hernia will give marked relief from the distress caused by symptoms of the ailment. But if the ailment is advanced or the symptoms are severe, it is best not to inject or to operate on the hernia except in case of strangulation or incarceration.

The operation and the injection treatment are contraindicated in patients with cancer, advanced diabetes, ascites, active syphilis and abdominal tumors. Hemophiliacs should not be subjected to either treatment because of the difficulty in controlling hemorrhage unless the clotting time of the blood can be shortened by medication, which is not very likely.

Hernias that cannot be held reduced by a truss should not be injected. If pain persists in a reduced hernia it should not be injected until the patient is symptom free. Pain of this sort is usually caused by intrasaccular adhesions, the sac and adherent omentum or viscera being reduced together into the abdominal cavity.

### Complications

Most surgical procedures developed to a high degree of efficiency and general usage pass through a period of criticism that is often unjustified. It is amazing how many surgeons using a so called new treatment fail to realize that complications may result not as a fault of the method but as a fault in the technique and management—a point they would grasp instantly if employing an old procedure.

Obviously complications may arise in both the operation and the injection treatment. I believe one reason that good results are being obtained with the injection treatment is that when there are complications they can, as a rule be more readily traced to their sources and classified in two groups: (1) those arising from the choice of solution and errors in technique, and (2) those resulting from mismanagement of the truss.

That the early writers understood this situation and were endeavoring to overcome the difficulties of treatment and the bad results they reported, is shown by present day accomplishment. Owing to the improved modern trusses designed especially for the injection treatment and to the safer and milder composition of the solutions, there has been an almost unbelievable reduction in the frequency of complications, their variety and severity. Such emergencies, how

ever, are always to be borne in mind, if we are constantly on the lookout and are prepared, we shall seldom be called on to meet them.

The complications are discussed at some length here for the sake of information and completeness, and to show the progress this treatment has made in a comparatively short time.

### Complications Due to Solutions and Technique

**1 Pain**—The injection of mild sclerosing solutions for hernia seldom causes pain, but when it does the pain is limited to the site of injection, is not severe and subsides in a few minutes or half an hour. Now and then it radiates a short distance down the cord. Should some of the solution reach the peritoneal cavity, either by direct injection or through the sac, it causes abdominal pain and discomfort. No special treatment is needed beyond a mild sedative such as aspirin or codeine.

The injection of strong solutions frequently causes disabling complications. Pain at the site of injection may require the patient to discontinue his usual activities for a day or two and rest, with ice caps applied to the painful area.

Pain caused by the use of strong solutions of tannic and gallic acids, thuja, pinus canadensis and alcohol does not develop for one or two hours after injection. By that time the patient may be so far away from his doctor's office, perhaps traveling to his destination, that it may be difficult or impossible for him to stop and rest.

**2 Hydrocele of the Cord**—Hydrocele sometimes develops when the neck of the sac is obliterated while the portion lying in the cord is not destroyed. This is caused by the irritation of the injections and usually clears up in a few days without treatment, if it persists for two or three weeks, the hydrocele should be aspirated.

**3 Bladder Injury**—The bladder will almost never be punctured if it is emptied before treatment. Elderly men with prostatic hypertrophy and chronic urinary retention should always be catheterized before having their hernias injected.

**4 Strangulation**—A patient who discontinues the treatment after a few injections or discards his truss before the hernia stops coming down is in more danger of strangulation than if he had not begun treatment, because the hernial ring contracts after the first injections, thus applies especially to femoral hernia. With treatment begun, it should be carried through as quickly as consistently possible.

**5 Drug Allergy**—Acute coryza sometimes follows the use of tannic and gallic solutions, even with the new colloidal preparations. When there is this idiosyncrasy, treatment can usually be continued without interruption if another solution is substituted. Any of the sclerosing solutions should be used cautiously in patients suffering with asthma, hay fever, coryza or angioneurotic edema. No matter what fluid is employed, the first injection should be very small to test the patient's tolerance to the particular drug or preparation.

**6 Complicating Diseases**—Patients handicapped by a debilitating disease, such as myocarditis, hyperthyroidism, etc., should receive one half or one third of the usual amount of the novocaine and sclerosing solution, and there should be no adrenalin in the anesthetic.

**Infants and Children**—These small patients should receive only one fourth or one half of the amount of solution used in an adult.

### Complications Due to the Truss

**1 Dermatitis, Eczema and Blebs**—These complications rarely develop as a result of the irritation and pressure caused by the truss pad. They can be checked by applying tincture of benzoin to toughen the skin, placing soft felt or absorbent cotton under the truss pad, and by changing the pad to a type that is softer.

**2 Edema and Inflammation**—Edema of the groin, scrotum or prepuce is due to the pressure of the truss, while thickening of the cord, varicocele, epididymitis and orchitis are primarily due to the injections and are aggravated by the truss. These complications are usually associated with the elderly and obese, being the result of low resistance. As a rule no treatment is indicated, the injections being discontinued for a few days.

**3 Strangulation and Irreducibility**—If the hernia slips by the truss pad during injection treatments there is always danger of strangulation or irreducibility, as omentum may become adherent to the sac wall or a large mass of it may slip out and it is difficult or impossible to reduce through the narrowed ring. This complication is to be guarded against especially in femoral hernia, because of the tortuous course of the canal and the unyielding boundaries of the femoral ring. Reduction of femoral hernia is carried out by flexing the thigh at the hip and rotating it inward to relax the femoral ring.

If the femoral truss pad makes too much pressure over the femoral vein or if too much solution is injected near the vein, there is sometimes a slight swelling of the ankle and foot on the injected side, this does not cause pain or inconvenience and subsides in a day or two.

Truss pressure must be firm and continuous in large umbilical hernias with small rings. If the omentum or intestine slips by the truss pad, reduction may become difficult.

**4 Noncontrollable Hernia**—When intraabdominal pressure is strong and the truss cannot be fitted to hold the hernia the patient should be put to bed and given a few injections before he is again allowed to be on his feet. If obese, as is usually the case, he should be put on a reducing diet.

### Miscellaneous Complications

**1 Serious Conditions and Accidents**—Complications such as sepsis, cellulitis, general peritonitis, gangrene of the skin, perirectal abscess, thrombosis of the deep epigastric artery, iliac and femoral vessels, needle puncture of the iliac or femoral vessels and intestinal fistula have been reported in the literature, but I have never encountered any of them. Should they occur, their treatment is essentially surgical. Many of these conditions have been widely

quoted from the writings of Goldbahn and have discouraged some surgeons in using the injection method. To begin with, alcohol was the injection fluid ordinarily employed. A careful review of his work indicates that of the cases he reported many patients had unreduced abdominal viscera in the sac at the time of injection; and he failed to state whether or not a truss was used after treatment. Paraffin should never be injected (Fig 274).

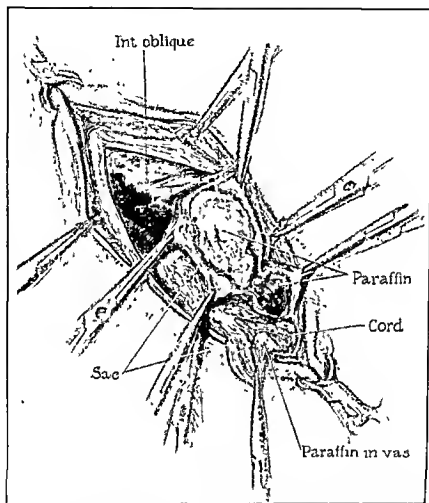


Fig. 274.—Paraffinoma of the vas deferens as a complication of paraffin injection for hernia.

**2. Operation After Injection.**—Should operation be required for any reason after injection, the newly formed scar tissue makes dissection of the cord, muscle and fascia a little difficult, but this does not bother an experienced surgeon any more than operation for postoperative hernia.

**3. Impotence and Sterility.**—I have never seen impotence or sterility follow the injection treatment of hernia. There may be a moderate degree of impotence, during active treatment, which ceases when the injections are con-

cluded. The condition is reflex, partly due to swelling and discomfort in the cord and groin. I have seen one case of impotence caused, the patient told me, by an operation performed three years previously. It was due to post-operative neuritis in the hernial sac.

Sterility is very rare. It can develop only from a complete blocking or severance of both vasa deferentia. The experienced surgeon places the injections at the fascial planes, at the inguinal rings and in the inguinal canal, always avoiding the spermatic cord. The occasional slight swelling of the cord, during the period of injections, is limited to the loose areolar tissue and to the thin investing layers of fascia, it does not involve the vas deferens because of its hard cordlike structure.

Rea studied twenty-six patients at the University of Minnesota Outpatient Clinic, who had had bilateral hernia injections. In every patient the spermatozoa counts were within the normal range. Rea concluded that, "Sterility would not therefore appear to be a complication of the injection treatment of hernia. Fear of such an occurrence should not deter employment of this method in the treatment of selected cases of inguinal hernia."

I believe the dangers of impotence and sterility following the injection method have been overemphasized by some writers and that there is only a remote chance of such complications with the proper technique and mild solutions.

**4 Atrophy of the Testis**—I have never seen atrophy of the testis following the injection for hernia and the condition is very rare. Both testes and the cord should always be examined before treatment is begun and the findings recorded on the patient's history card with the other data. Atrophy of the testis is found in 8 to 10 per cent of all patients with scrotal hernias who have never been treated.

**Statistics on Complications**—While the following statistics cover all types and conditions of hernia, many of them occurred in simple reducible hernias. Surgeons opposed to the injection method concede that the operation carries some hazard at all times. In one hospital I know of three patients who died recently of pulmonary embolism following simple hernia operation.

Gibson and Felter collected the records of 1618 hernia operations performed in a leading hospital, and found the following immediate complications, wound infections 70, hematomas 59, orchitis 21, accidental incision of bladder 2, of spermatic cord 1, of large artery 1 and of sigmoid colon 1.

The secondary complications included cough 30, pneumonia 34, pulmonary tuberculosis 5, bronchitis 3, infarcts 8, laryngitis 1, influenza 1, empyema 1, hydrocele 74, varicocele 23, epididymitis 2, a total of 368 complications in 1,618 hernia operations.

Though by means of dissimilar approach, the operation and the injection method accomplish the same purpose—the cure of the hernia. Such different situations maintain in process of both treatments that a dependable comparison of the two is difficult to make excepting in regard to the results. With reference to the statistics above, I would remark that owing to the technique of the injection treatment, the high percentage in certain complications does not occur. The



method being ambulatory eliminates the pulmonary complications, the slight trauma caused by the injection eliminates wound complications and minimizes swelling of the cord and testis. It is well to remember that injecting needles which are too large or those with dull rough points have been responsible for some of the serious accidents reported in the literature, such as the puncture of unreduced intestine in a hernial sac.

## SOLUTIONS, SYRINGES, AND NEEDLES

### Solutions

At the present time there is a wide variety of solutions for the injection of hernia, the general tendency being in favor of the mild fluids. I have given careful study to these injection fluids testing the many mixtures from every angle and observing their action, immediate and remote. During this study practical incidents emphasized the superiority of clinical investigation over the experimental—results always being more impressive than theories.

The ideal injection solution for hernia should have the following characteristics:

- 1 The injection solution should be actually painless; a preliminary anesthetic not needed.
- 2 No after pain at any time should follow the injection.
- 3 The solution should be nontoxic if accidentally injected into the peritoneum or into a vein.
- 4 There should be no allergic or systemic reaction.
- 5 There should be prompt proliferation of strong fibrous nonabsorbable tissue.
- 6 There should be no tendency to tissue necrosis or abscess formation.

I have always questioned the necessity for caustic and violently irritating solutions, believing that the same results can be obtained with the milder fluids. In a search for a satisfactory solution I have worked out the following compound which meets most requirements and I have used it more or less continuously for years with uniformly good results.

### Procaine Quinine Phenol Anesthetic Solution —

Procaine (2 per cent solution)	—	9 fl. dr.
Quinine urea hydrochlorid	—	1 lr.
Phenol	— — — —	2 fl. dr.
Distilled water	— qs ad	— 4 fl. oz.

This solution is actually painless because it combines an anesthetic that acts immediately with one that takes effect more slowly but lasts for several days. The solution causes no after pain in the wound, it is particularly adapted to the single syringe technique with either single or multiple injections through one needle puncture, and it is usually all that is necessary for small inguinal hernias.

**Solution for Difficult Hernias**—Hernias that require more than the usual number of injections can usually be cured by adding silicon dioxide, grain 1,

and calcium fluoride, grain 1, to each 4 fluid ounces of the procaine quinine phenol mixture. For adults the dosage is 2 to 5 cc, but it should never be used for infants or children.

### Syringes

As a rule, surgeons have their own preference in the style of syringes, the size being more or less governed by the amount of solution to be injected. I use the 2 cc or 5 cc Luer glass syringe, depending on the amount of solution, and always employ the single syringe technique, giving two to five injections through one skin puncture.

A 2 cc syringe can almost always be used, and it has the following advantages. With the needle attached it can be held comfortably between the thumb and the forefinger as one holds a pen. Being small and light, the syringe is easy to manipulate. It does not drag on the needle, which moves less in the deep tissues than if a heavier syringe were used.

Perhaps the main objection to a large syringe is that, owing to the quantity of fluid it will hold, the surgeon is inclined to hurry the treatment by injecting too much at a time.

The syringes should be sterilized by boiling, never by soaking them in alcohol or other antiseptic solutions. If rinsed out with distilled water after using and if kept clean, they will remain airtight and serviceable longer than if they are neglected.

### Needles

The importance of choosing the suitable needle for the hernia injection is never underestimated by those experienced in this work. A complete assortment of needles on hand is necessary to meet the requirements of every patient.

The short bevel needle has countless advantages over the long bevel needle and is always to be preferred. It does not traumatize the tissues but spreads them, thus fitting snugly into the place it has made for itself. The short bevel edge is more comfortable for the patient and safer because there is less chance of puncturing the blood vessels or the peritoneum, and it minimizes seepage, reducing the danger of irritation in the skin and subcutaneous tissues.

Also, the short bevel needle is a valuable diagnostic aid, in that when it penetrates the fascia of the external oblique there is a distinct "give" that indicates the exact location of the point of the needle. The sensation is the same one would feel in passing a needle through a sheet of parchment paper. This "give" sensation is not obtained with the long bevel needle.

#### Length and Size of Needles —

##### ADULTS

1	Average musculature and build	--- - ---	1½	inch, 20 gauge
2	Unusually thin	--- - ---	1	inch, 22 gauge
3	Obese	--- - ---	2	inch, 19 gauge
4	Rolls of fat over inguinal region	--- - ---	2½	inch, 19 gauge
			or 3	inch, 18 gauge

**CHILDREN** For infants and children the length of the needle depends on the exact age of the little patient. For infants and young children a very

short needle perhaps  $\frac{5}{8}$  inch is used, for children over ten years old  $\frac{3}{4}$  to 1 inch is best. If the needle is too long there is a tendency to insert it too deep with the danger that accidentally it may enter the bladder or peritoneal cavity.

**Care of Needles**—The needles should be new or nearly so and of the best quality of rustless steel. Frequent skin punctures and deep insertions into the tissues soon bend them and dull their fine points. They must be kept straightened smooth and sharp. A soft oil stone or cake of sapolio will help to keep them in condition.

Needles should always be sterilized by boiling never by soaking in alcohol or in any antiseptic solution which is an uncertain method of sterilization at best. They should never be flamed as this destroys the temper of the steel.

### THE TRUSS

Those most experienced in using the injection treatment stress more and more the importance of proper fitting and adjustment of the truss at the same time advocating the wearing of the appliance considerably longer than was formerly believed necessary. Owing to the propaganda of some of the pharmaceutical houses too much emphasis has been placed on the importance of the injection solutions and the vital role of the truss has been subordinated.

To derive the maximum aid from this appliance it is imperative to have the complete cooperation of the patient and there are reasons why this is more difficult to obtain than would appear at first thought.

Every physician is familiar with those patients who diagnose their own ailments who if questioned are ready with a plan of treatment and seem to have sought advice only to have their opinions confirmed. I believe certain tendencies along this line are accentuated in any patient who cares for his own infirmity particularly when daily adjustment of some mechanical contrivance is necessary. Many of these hernia patients have been applying a truss for years observing its purpose in relation to their subjective and objective symptoms and it would be surprising if they did not come to some sort of conclusion in their own minds as to what is best and most comfortable for them.

My experience has been that without exception every experienced truss wearer presenting himself for the injection treatment promptly asserts his opinion on the subject of his truss taking for granted that he—not I—is the one to dictate truss routine. I am sorry to admit that most of my failures with the injection some time ago were due to the fact that I permitted the patient to select his truss and set the hours in the day that he was willing to wear it of course the annoyance of keeping it on at night made that out of the question.

This being the true state of affairs there is a definite course to follow. Before treatment is begun the purpose and value of the truss should be explained to the patient pointing out that the simple retention of hernia by a truss and the firm continuous pressure required for the injection treatment are two different things and the latter requires a special type of truss perfectly fitted and worn precisely according to the physician's directions.

Even when accustomed to wearing his truss under other conditions the average patient can be persuaded to see that the success of his treatment depends on his cooperation.

**The Best Truss for Injection Treatment.**—The ordinary frame or spring truss is not suited to the injection method. I have given it an extensive trial, and, regardless of the injections, one cannot obtain more than 50 per cent of cures in the average run of patients.

I have secured the best results with a semi-elastic body-band truss having a large thick molded soft rubber cushion to fit over the pubic bone and hold the hernia inside the inguinal canal. The cushion is 2 inches thick over the hernial opening and only 1 inch thick where it fits over the pubic ramus. It is always necessary to wear a snug-fitting thigh strap to hold the lower end of the cushion down close to the pubic ramus. The truss must be worn day and night and never removed except for the injections.

It is usually necessary for the pad to reach the edge of the rectus muscle in order to cover the hernial opening. For direct hernia in the obese subject, an extra-large cushion pad is used, along with a smaller pad on the sound side to balance and keep the larger pad from slipping.

Small, medium, and large cushion pads are used. It is best to start with a large size and, as the hernia reduces in size, fit a smaller cushion pad.



Fig. 275.—A and B. A spring type truss with soft leather hernial pad and double back pad. This truss is indicated for large hernias in obese subjects. (Courtesy of Physicians and Hospitals Supply Co., Minneapolis, Minn.)

Should the cord be irritated by truss pad pressure, it is advisable also to use a thin pad of sponge rubber with a crescent shaped section cut out to fit over the cord.

When it is difficult to hold a direct hernia by the truss, the leg strap can be passed around the opposite thigh or, better still, a leg strap for each thigh. Often a broad pad of sponge rubber can also be used for the first few treatments. When an inguinal truss fails to hold a hernia, it may be accomplished by using a femoral truss with a tight-fitting leg strap.

Women with indirect inguinal hernia are often most comfortable with an elastic belt femoral truss with leg strap.

**Wearing the Truss Previous to Treatment.**—For the following reasons it is advisable for the patient to wear a truss for a few days before injections are begun:

1. To be sure the hernia cannot slip by the truss pad
2. To become accustomed to the steady firm pressure peculiar to the injection truss.

3 To toughen the skin over the hernia so the truss will not have to be removed during treatment on account of irritation or blisters caused by the rubbing of the truss pad, waistband, or thigh strap

4 To be certain that the truss relieves all the hernia symptoms (Fig 275, A and B)

**Instructions for Wearing the Truss**—Those who have had the most experience in using the injection treatment stress more and more the fitting and adjustment of the truss, at the same time advocating the wearing of the appliance longer than was formerly believed necessary

If patients are provided with a printed page of simple yet complete instructions, they are able to cooperate with more understanding, consequently they make better progress and are more comfortable throughout the duration of their treatment. I have formulated the following rules and have been surprised at the number of patients who have endeavored to adhere to them, their improvement often being proportional to their success in this respect

#### INSTRUCTIONS FOR PATIENTS AFTER INGUINAL HERNIA INJECTION

The fitting and adjustment of your truss are important. I have prepared this page of simple instructions to advise you among other things on the wearing of your truss so that you will make the best progress and be most comfortable throughout the period of your treatment

1 A firm truss must be worn day and night throughout the treatment and for two months after the last injection. It must be worn next to the skin, never over the underwear. During this time you must not remove it under any circumstances. Most trusses are impervious to water, but, if such is not the case, a bathing truss should be worn, or only sponge baths taken. Rubbing of the skin with a turkish towel will keep it clean for a long time when a tub or shower bath is impracticable. The truss will fit better and slip less if suspenders are worn to support the trousers, instead of a belt.

2 Two months after the last injection the truss can be removed at night but must be worn in the day time for the next four weeks. During the following three months it is worn only when you are actively engaged at work or recreation, and then it is discarded.

3 When it is time to discard the truss, it should be gradually loosened a little each day for a week, before leaving it off entirely.

4 If you should develop influenza, a cold, cough or pneumonia within six months or a year after being cured of hernia, you should return to your truss and wear it day and night continuously until the respiratory irritation and the cough are gone.

5 Take no setting up exercises or calisthenics while under treatment for hernia or for a year afterward, and do not swim.

6 If you are wearing a truss for the first time, keeping it on day and night may cause some discomfort. This can be relieved by taking a mild sleep inducing tablet for a few nights, and by placing soft felt or cotton under the truss where it rubs the skin beneath the hernia pad, the back pads, and the thigh strap in the groin.

7 The newly formed fibrous tissue that has closed the hernial opening must be protected from stress and strain. Just as a hernia operation wound must be favored and recurrences prevented by wearing a truss or firm binder for several months, so must the injection wound be protected. The truss should be worn for any unusual effort, perhaps heavy work, lifting or climbing. There must be no gain in weight for a year after treatment because of the strain it would add to the wound.

8 Constipation and straining must be avoided by including an abundance of fresh fruits and vegetables in the diet, and drinking a sufficient amount of water, or by taking a laxative. The truss should be worn if straining at stool, for six months after treatment. Highly acid fruits such as lemons, oranges, grapefruit and tomatoes should be avoided. Gas forming vegetables, beans, peas, onions, cabbage, and bananas, are liable to cause discomfort.

## GENERAL PRINCIPLES OF TECHNIQUE

**Training and Experience**—A thorough knowledge of anatomy is imperative for diagnosis alone. There is no branch of surgery in which diagnosis may be more difficult than in inguinal and femoral hernia, and it is on this point that success or failure with the injection method sometimes hinges.

The diagnosis made, the injection of sclerosing fluids into the abdominal region, by a surgeon lacking easy familiarity with the anatomical landmarks and contiguous structures constitutes even a greater hazard than the operation performed by untrained hands. The injection method has been criticized as a "blind" procedure. Of course, the degree to which it is blind depends largely on the surgeon's anatomical knowledge. If this is accurate, the fact that he is penetrating structures concealed from view by the skin and subcutaneous tissues does not interfere with the field of injection pictured in his mind's eye through his visualizing finger tips.

The surgeon beginning to use the injection treatment will find it helpful when about to operate for hernia if he will inject a weak solution of methylene blue into the region of the internal ring and inguinal canal, proceeding with the operation, he can ascertain whether or not his injections were placed at the proper sites.

J. G. Frost, the chief surgeon of the Chicago and Eastern Illinois Railroad, states: "I strongly feel that one of the serious dangers confronting us in the advancement of this injection form of treatment is the fact that it will be considered a minor surgical procedure and be practiced by surgeons who have not been thoroughly schooled and trained in the technique of its administration, and the inevitably unsatisfactory results will thus have a tendency to retard the progress of what is really a very important surgical procedure."

E. M. Stanton writes, "One of the chief hazards which is almost inevitably, for a time at least, going to be associated with the injection treatment, will be the inexperience of the injectors."

**Physical Examination**—Following the diagnosis of the hernia, all the usual hernial openings should be examined, and scars or weak spots in the abdomen noted. In men look for hydrocele, varicocele, and epididymitis. The size of the testes should be recorded. Atrophy on the herniated side is common, McMullan and Cunningham estimate it at 8 per cent. With old hernias this condition is usually caused by truss pressure on the cord structures which interferes with the normal circulation in the testes.

**Case Records**—There is more detail associated with the cure of hernia by means of the injection method than by the operation, and there are several reasons why complete case records on the injection treatment should be kept.

When patients with different varieties of hernias are at diverse stages of progress, their treatments being given at varying intervals of time, it is impossible to meet their respective requirements without the aid from this source. Also it helps the surgeon to carry out the treatment in the least time compatible with thoroughness and skill.

The injection method being comparatively new, the information accumulated by means of the record card is of particular scientific value as well as of

medicolegal importance impossible to estimate. Most important, perhaps, is that, as the surgeon prepares to treat a patient, he must have dependable data before him to confirm the situation he finds in the field of injection. Besides the usual clinical record the card for each patient should name the solution used, the size of the injection, a general idea as to the location of previous injections and any immediate or remote reaction that has followed.

When a number of patients are under treatment, it is advisable to print the name of the patient and the date treatment was started on the inside of the truss belt with an indelible pencil. If the hernias are bilateral, this can also be noted, as well as which hernia is the larger.

**Multiple Injections by Single Syringe Technique**—The single syringe technique is more comfortable for the patient than the two syringe method, and correspondingly convenient for the surgeon. The single syringe technique requires a solution that is painless.

Two to four small injections, usually 2 cc each, are given at different points through one skin puncture. The advantages of this method are as follows:

1 The period of time required for cure is shortened to approximately the same as that needed for the radical operation and convalescence.

2 It is easy to avoid injury to the large nerves because they are not numbed by a preliminary anesthetic. The patient's pain reflex is preserved and as in all surgical situations it is the operator's best aid. With the needle inserted, if the patient complains of pain it is a simple matter to angle it to a less sensitive point for the injection.

### Amount of Solution for Each Injection

The amount of solution to be injected *per dose* depends on the health, weight and age of the patient, the variety of the hernia and its size, the patient's reaction to the injections, and the frequency of the treatments.

1 **Average Patient**—Patients of normal weight in the active years of life, and the obese and overweight require larger injections than infants, children, young people, the elderly, and those patients handicapped by disease.

2 **Nervous Patient**—Nervous patients who are hypersensitive to minor discomfort and pain should receive small injections. These patients cannot help their sensitiveness to pain and if they are hurt much they simply discontinue treatment.

3 **Varieties of Hernia**—Certain varieties of hernia require different amounts of the injection fluid. Femoral hernia takes the least, epigastric, small umbilical, and postoperative hernias take slightly more, in the order named. The voluminous inguinal hernias ordinarily tolerate the largest injections.

4 **Allergy**—Some patients, for no known reason, experience more local and systemic reaction to the injections than others do. For these the amount of solution should be cut down.

5 **Size of Injection**—As a rule I believe the injections are most effective if given two or three times a week. If given daily, as is sometimes indicated, the solution should be only half the regular amount. If given weekly the amount can be a little larger than that used two or three times a week.

### Angle of Needle During Injection

When injecting the internal ring and the upper part of the inguinal canal, the needle should be directed downward, at an angle of 45 degrees, to the fascial plane in the long axis of the body. By this course the needle passes nearly parallel with the peritoneal fold at the internal ring, and the danger of entering the abdominal cavity is greatly reduced.

To inject the lower part of the inguinal canal, the external ring and Hesselbach's triangle, I usually insert the needle at an angle of 90 degrees, or at a right angle to the skin. When the hernial sac is large and injections are made near it, the needle should be angled at 45 degrees so as to reach the fascia with the least danger of puncturing the sac.

It is never advisable to try to inject a hernia from below through the serotum. In passing the needle through the inguinal canal to the internal ring, there is danger of injuring the cord and accidentally entering the peritoneal cavity.

### Depth of Injection

The depth of the injections depends largely on the thickness of the abdominal wall, the age, sex, muscular development, and general health of the patient. The most important and variable factor is the amount of subcutaneous fat. For young children a needle  $\frac{5}{8}$  inch long is sufficient, while very obese adults may require one 3 inches long.

If a needle of proper length is selected, there is less danger of entering the peritoneal cavity than if the needle is too long.

If the injection is made in the subcutaneous tissues or superficial to the aponeurosis of the external oblique it not only will be useless but will cause a hard painful nodular mass to form that will interfere with the comfortable adjustment of the truss.

### Number of Injections

The number of injections required to cure a hernia depends on the following factors:

**1 Age of Patient**—An elderly patient requires a greater number of injections than the young adult with a similar hernia. Infants and young children require fewer injections than adults.

**2 Variety of Hernia**—Direct inguinal hernias require more treatment than the indirect. The umbilical, epigastric and femoral varieties do not need as many injections as indirect hernias. On the other hand, postoperative ventral hernias require more injections than any other type of hernia.

**3 Amount of Injection Solution**—Patients who are nervous, debilitated, frail, and sensitive to slight pain should receive one half or one third of the amount of solution usually given in one injection. This necessitates giving about twice as many injections as for the average patient.

### Frequency of Injections

There is no hard and fast rule governing the length of time that should be allowed to elapse between injections. A good deal depends on the wishes



or convenience of the patient whether he wants his hernia cured quickly, and in order to accomplish it is willing to tolerate the possible soreness caused by intensive treatments, or if there is no reason to hurry his cure his comfort during treatment may be his first consideration impelling him to take his injections in more leisurely fashion

With the mild solutions however, it seems to me the most uniform results follow two or three injections a week Under this routine the patient notices improvement early in his treatment without the discomforts associated with intensive injections When after four to six injections his hernia no longer comes down he is more cooperative because he realizes he is actually being cured Many patients remark at about this stage in treatment that they can feel the ring tightening

### What the Injection Accomplishes

The cure of hernia consists in tightening the hernial rings closing the inguinal canal snugly over the cord and disposing of the sac This result can be attained by operation or by means of the injection method

The injection produces a general fibrosis which unites the external oblique aponeurosis the internal oblique and transversalis muscles and fascia so that the sac is obliterated and only a narrow pathway remains in the reconstructed inguinal canal for the passage of the spermatic cord

Except for the high excision of the sac and the placing of a musculofascial barrier behind the transplanted cord the operation accomplishes little more than the injection method in small indirect hernias

### Operation After Injection

There is an opinion among the inexperienced that operation for the cure of hernia recurring after the injection treatment is more difficult than operation for hernia recurrent after the operation This is a mistaken idea well expressed by Gordon and Gordon who state "Previous injections and fibrous tissue proliferation resulting from the injections in no wise interfere with the operative procedure or the operative results

The dissection of the fascial layers is sometimes tedious but it presents no particular difficulty for the surgeon experienced in hernia operations The cord is usually easier to find and isolate after the injections than after post operative recurrence

## CHAPTER XXXIX

### INJECTION TREATMENT OF HERNIA (Cont'd)

#### TECHNIQUE FOR INJECTING INGUINAL HERNIA

##### Preinjection Technique

**Preparation of the Skin**—The skin over the hernia is prepared for the injection the same as for operation. The long hair is removed with clippers, then the field of injection is shaved. For office work, I find that a mixture of liquid soap and alcohol 10 per cent makes a good shaving lather as well as an efficient antiseptic for the skin. Also this mixture softens the skin and lessens its resistance when the needle is inserted.

**Examining and Outlining the Hernia**—The hernia is examined first with the patient in the standing position. With the index finger of the examining hand, invaginate the scrotum, note the size, location and position of the rings, the direction of the inguinal canal and the length of it, and the thickness of the internal oblique muscle, transversalis muscle and fascia. Now ask the patient to cough or strain, which forces the hernia to distend the sac, and with a skin pencil or soft draughting pencil, trace the outline of the hernia.

Next place the patient on the table in a recumbent position, reduce the hernia, and mark on the skin the location of the external and internal rings. Draw a line from the upper limit to the lowest point of the hernia outline, with the hernia reduced, this line indicates fairly well the location of the hernial sac. When treating women, always bear in mind that the inguinal rings and canal are more lateralward than in men, on account of the greater width of the female pelvis. Palpate the pubic tubercle and locate the external inguinal ring.

**Position of the Patient on the Table**—Place the patient in a horizontal position on the treatment table, which is then adjusted to give a slight Trendelenburg position. In this position the abdominal contents gravitate away from the inguinal ring, minimizing the chance of the injection needle entering the peritoneal cavity, with hernias that are difficult to keep reduced this position forces the hernial contents out of the sac into the abdominal cavity.

The truss must be removed for the injection and replaced immediately after the injection while the patient is still recumbent on the table. For three or four treatments the surgeon should remove and replace the truss for the patient whose effort in adjusting it might cause the hernia to come down. After the first few treatments the patient has probably learned to take off his truss and put it on without danger of the hernia slipping.

**Sites for Injecting Indirect Inguinal Hernia**—The first injection is usually made at the upper part of the internal inguinal ring. To locate this point draw a line from the anterior superior spine of the ilium to the pubic spine. The

internal ring is located approximately 1 cm above the center of this line and 0.5 cm to the inner side of it

A quick method of locating the internal ring is to place the thumb of the examining hand on the pubic spine, the middle finger on the anterior superior spine of the ilium, and the index finger at a point just above the middle and a little to the inner side of a line passing between the two landmarks. The inguinal ligament is often palpable and is a valuable landmark in locating the inguinal canal. I find it most helpful when injecting inguinal hernias in women.

After the internal ring is injected, as described under Technique, the inguinal canal is injected at intervals of 0.5 cm until the external ring is reached, where several injections are made. Two or three injections are made into Hesselbach's triangle to prevent the future development of a direct hernia (Fig. 276)

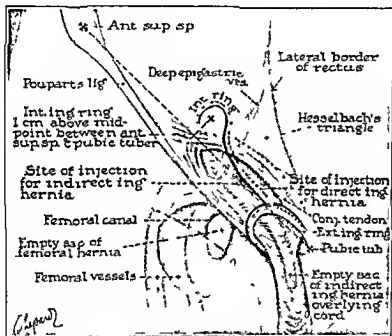


Fig. 276—The sites for injecting direct and indirect inguinal hernias

**Sites for Injecting Direct Inguinal Hernia**—The first injection for direct hernia is usually made in Hesselbach's triangle, below the cord and to the inner side of it. Subsequent injections are made 0.5 cm. apart, in the transversalis fascia and external ring until the entire area is injected. The new external ring fits snugly around the cord, and the weak spot in Hesselbach's triangle is closed. Two or three injections are made at the internal ring to strengthen it.

#### Injection Technique for Indirect Inguinal Hernia

1 The patient is fitted with a comfortable truss that holds the hernia under all conditions of exercise or work.

2 The diagnosis of the variety of hernia direct or indirect, is confirmed and the patient placed on the treatment table. The field of injection is prepared by clipping the long hair, then shaving and applying an antiseptic, preferably liquid soap and alcohol 10 per cent.

3 The table is tilted to a slight Trendelenburg position, which causes the abdominal viscera to slip away from the internal ring, out of harm's way. The examining index finger invaginates the scrotum, examines the rings and palpates the sac to make certain it is empty. In the elderly the external oblique aponeurosis above the external ring should be examined for splits in the fascia and possible ventral hernias.

4 Next anesthetize the skin with ethyl chlorid spray over an area 1 cm in diameter at the point where the needle is to be inserted.



Fig. 277.—Method of inserting the needle through the skin.

5 Insert the needle attached to the syringe containing the injection fluid, through the skin at the center of the area of anesthesia. I always pick up the skin over the injection site and hold it between the thumb and index finger while I insert the needle into it thus avoiding the danger of inserting the needle too deep with the first puncture. (Fig. 277.)

6 Release the grasp on the skin and with the index or middle finger of the free hand invaginate the scrotum the finger tip palpating the external ring. Never insert the examining finger into the external ring after the first injection has been given.

7 Point the needle downward at an angle of 45 degrees and pass it through the subcutaneous tissues down to the fascia with the finger tip on the external ring acting as a guide, pierce the fascia at a point over the internal ring. That you have punctured the fascia is confirmed by a "give" in the needle a feeling

similar to the sensation that would be experienced from thrusting a needle through a sheet of parchment. The sensation is more distinct when a short bevel needle is used, and, because it is so much safer than a long bevel, a short bevel needle should always be used (Fig 278)

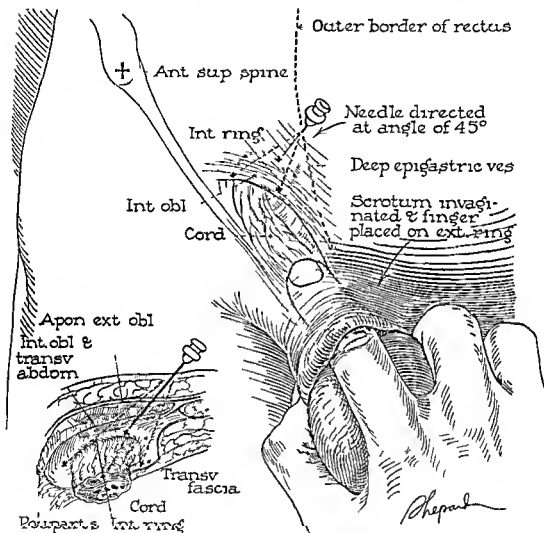


Fig 278.—Technique for injecting the internal ring

8 When the tip of the needle has passed through the fascia and into the internal ring, it is no longer held rigid by the tissues, with the fascia as a fulcrum, the needle and attached syringe will move freely in a circle or in any direction desired. Guided by the index or middle finger to palpate the internal ring, move the needle so that the injection will be placed in the edge of the muscle and fascia that form the internal ring, one half inch below the aponeurosis of the external oblique. From three to four multiple injections are usually required to encircle the ring (Figs 279 and 280)



Fig 279.—Injection of the inguinal canal the needle beneath the aponeurosis of the external oblique

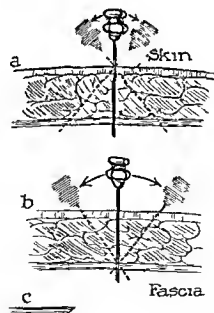


Fig 280.—(a) Showing needle puncturing the fascia (b) showing how the needle can be moved freely in any direction when it is beyond the fascia (c) short bevel point of needle.

9 Aspirate the syringe to be certain the needle is not in a blood vessel then inject 2 c.c. of the solution as slowly as you can. Withdraw the needle  $\frac{1}{2}$  inch and press it through the fascia to reach another part of the internal ring again slowly inject 2 c.c. of solution.



Fig. 281.—The multiple injection technique. The location of the anterior superior spine of the ilium, the epine of the os pubis and the internal inguinal ring are marked on the abdomen. The needle is inserted through the skin at an angle of 45 degrees and 2 c.c. of the solution is injected into the upper edge of the internal inguinal ring.



Fig. 282.—The multiple injection technique. The needle is partially withdrawn, reinserted into the outer edge of the internal inguinal ring and 2 c.c. of solution is injected.

As a rule with the multiple injection technique I give three or four small injections as described above through one skin puncture. Do not neglect to inject the muscle directly above the ring because this reinforces the ring just as the Coley stitch reinforces it in the operation. (Figs 281-282)

Thoroughly inject the sac beyond the external ring during the first treatments so as to avoid the possibility of strangulation through the narrowed hernial rings



Fig 283—The multiple injection technique. The needle is again partially withdrawn and reinserted into the inner margin of the internal inguinal ring and 2 c.c. of solution is injected



Fig 284—The multiple injection technique. Injection of the inguinal canal. With the index finger of the free hand as a guide, the cord is held aside and the transversalis fascia forming the floor of the inguinal canal is injected just below the internal inguinal ring with 2 c.c. of solution. The 4 injections are made from the proximal or inner side of the cord.

10 If the patient complains of pain following the insertion of the needle below the fascia it may mean that the needle has penetrated the peritoneum or that it has been inserted too close to the cord or too near one of the larger nerves. If the needle is partly withdrawn and reinserted a non sensitive spot can usually be found about 0.5 cm distant and the injections continued



The needle should be angled at 45 degrees when injecting the internal ring, to avoid the peritoneum. For other injections it can be inserted at 90 degrees, at right angles to the skin. When the solution flows freely, without the least



Fig. 235 —The multiple injection technique. The needle is partially withdrawn, reinserted into the center of the floor of the inguinal canal and 2 cc. of solution is injected.



Fig. 236 —The multiple injection technique. The needle is partially withdrawn, reinserted into the lower portion of the inguinal canal near Poupart's ligament and 2 cc. of solution is injected.

resistance on the plunger of the syringe it is best to stop the injection to make certain that the needle point is in the right place and not in the peritoneal cavity or hernial sac.

11 The slower the solution can be injected the more effective it will be, and the patient will be correspondingly more comfortable after treatment. The most frequent mistake made by beginners is to give insufficient injections around the internal ring and into Hesselbach's triangle.



Fig. 257—The multiple injection technique. The needle is partially withdrawn, reinserted into the lower third of the inguinal canal and 2 c.c. of solution is injected.



Fig. 258—The multiple injection technique. The needle is partially withdrawn, reinserted into the lower and outer portion of the fascial floor of the inguinal canal and 2 c.c. of solution is injected.

12 After the injections are completed through one skin puncture, aspirate the syringe while withdrawing the needle so that no solution can lodge in the subcutaneous fat or skin.

13 After the internal ring has had sufficient injections the next step is to treat the inguinal canal. Ordinarily the inguinal canal is about 1.5 inches (3.75 cm.) long but in large hernias the obliquity diminishes bringing the two rings almost together. The spermatic cord is usually spread out so that the blood



Fig. 289.—The multiple injection technique. Injection of the upper margin of the external inguinal ring with 2 c.c. of solution.



Fig. 290.—The multiple injection technique. The needle is partially withdrawn, reinserted into the outer margin of the external inguinal ring and 2 c.c. of solution is injected.

vessels cover the entire external and posterior surface of the sac and the vas deferens is situated behind the sac.

14 The inguinal canal is injected from its proximal or inner side at intervals of 0.5 cm. from the internal to the external ring. I give three or four multiple injections into the canal by the single syringe technique (Fig. 293.)

With the index finger of the free hand as a guide, the cord is held aside and the needle directed to the floor of the inguinal canal, which is formed by transversalis fascia. It is important to place the injections close to the inguinal ligament. Owing to the proximity of the cord, the injections in the canal are smaller than those in the internal and external rings.



Fig 291.—The multiple injection technique. The needle is partially withdrawn and inserted into the fascial floor of Hesselbach's triangle and 2 c.c. of solution is injected.



Fig 292.—Left inguinal hernia in a woman. Technique for injecting Hesselbach's triangle.

15 Next, three or four treatments are given at the external ring. Each one consists of three to four injections of 2 c.c. of the solution given through one skin puncture, the number depending largely on the size of the hernia.

16 Finally, two or three treatments are given to strengthen the lower half of Hesselbach's triangle, each consisting of three or four multiple injections

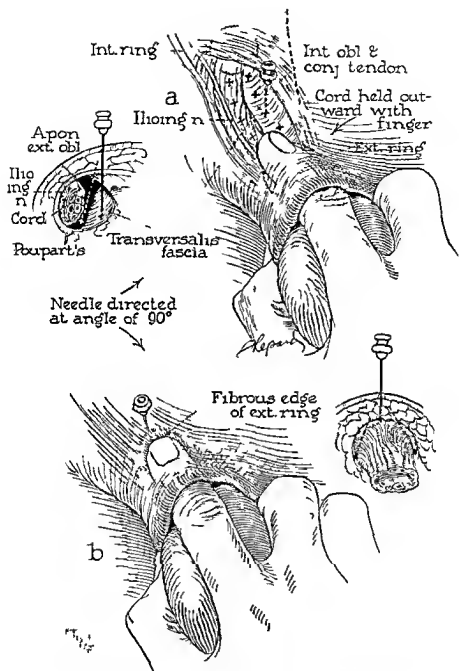


Fig 293—Technique for injecting indirect inguinal hernia (a) injection of inguinal canal (b) injection of the external ring

through a single skin puncture. These extra injections are to prevent the possible development of a direct hernia at a later time.

17 Injections must be placed at close intervals entirely around the internal ring, on both sides of the external ring and in the upper part of it, and entirely around the ventral and umbilical hernial rings. Neglect of this apparently unimportant step in the technique is to court failure, because this untreated spot is left without the support of the newly formed fibrous tissue that reinforces the rest of the ring and causes it to weaken and bulge. Obviously, the result is failure to cure or an early recurrence (Fig 294). For the best results the tip of the needle should be in the muscular and fascial edge of the inguinal ring.

18 When the patient is eager to experience quick results from the treatment, it is sometimes advisable to begin the injections at the external ring instead of at the internal ring. By this plan the hernia seldom comes down after the third or fourth treatment, even if the patient takes off his truss to test the efficiency of the method.

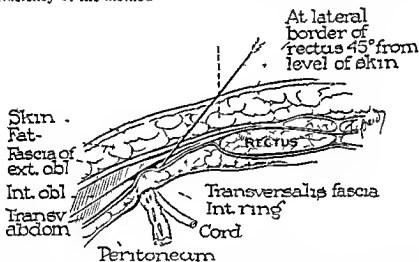


Fig 294—Injection of the internal ring. Transverse section of left internal inguinal ring.

If blood appears in the syringe the needle should be immediately withdrawn and firm pressure made over the area for five to seven minutes, to prevent the formation of a deep hematoma.

### Injection Technique for Direct Inguinal Hernia

Direct hernia nearly always comes through the weak spot in Hesselbach's triangle, then traverses the lower part of the inguinal canal, and makes its exit at the external ring.

The weak spot is bounded internally by the fascia of the transversalis muscle, which runs from the upper surface of the pubis to the rectus, and externally, by similar fibers from the transversalis muscle, which encircle the inner border of the internal ring and fuse with the inner surface of the inguinal ligament. Direct hernias never extend into the scrotum, but the external ring is large for the apparent size of the hernia (Fig 295). Many of the so-called

recurrent hernias are new direct inguinal hernias following the treatment of indirect hernia. For this reason it is most important routinely to inject Hesselbach's triangle and the inner side of the external inguinal ring.

Injections are made into the transversalis fascia below and internal to the cord, into the weak spot in Hesselbach's triangle, and into the muscular and fibrous edge of the external ring. I use multiple injections with the one syringe technique, giving three or four infiltrations of 2 cc. of the solution through one skin puncture.

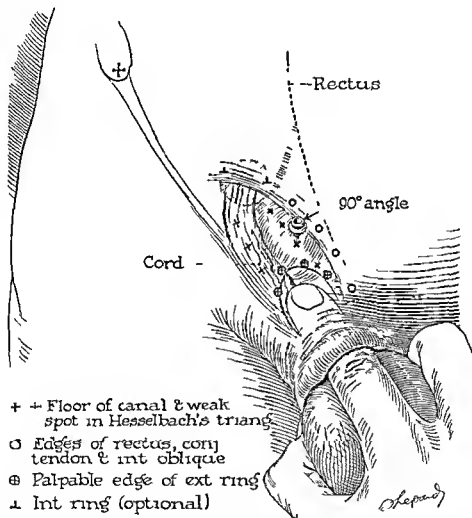


Fig. 295.—Direct inguinal hernia. Sites for injecting Hesselbach's triangle, the inguinal canal and internal ring. The cord is displaced laterally so the transversalis fascia can be injected.

The skin is anesthetized by ethyl chlorid spray, and the needle inserted at a point approximately over the upper and outer border of the external ring. The scrotum is invaginated by the index or middle finger of the free hand, the cord palpated and displaced outward as the needle is slowly passed along

the inner side of the cord. When the needle point is below the cord, it is guided to the site of injection by the tip of the finger.

The principal points for injection of direct inguinal hernia are the following:

1 The transversalis fascia, which forms the floor of the inguinal canal. Injections are made at  $\frac{1}{4}$  inch intervals from the internal to the external rings.

2 The edges of the rectus muscle and conjoint tendon,  $\frac{1}{4}$  to  $\frac{1}{2}$  inch internal to the inner lower angle of the external ring, just above the pubic bone.

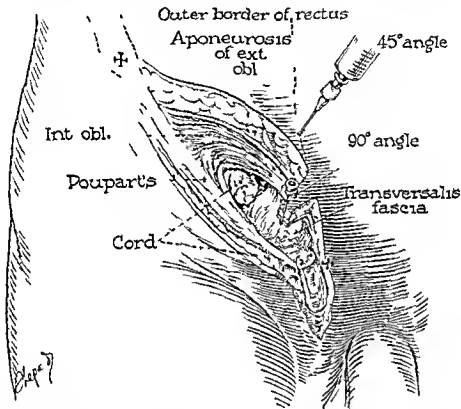


Fig. 296.—Technique for injecting inguinal hernia. Showing the angles of the needle for upper and lower injections of the transversalis fascia.

3 The edges of the rectus and internal oblique muscles  $\frac{1}{4}$  to  $\frac{1}{2}$  inch internal to the inner upper angle of the external ring, about 1 inch above the pubic bone.

4 The edges of the internal oblique muscle and the inguinal ligament,  $\frac{1}{4}$  inch external to the lower outer angle of the external ring.

5 The edge of the internal oblique muscle,  $\frac{1}{2}$  inch external to the upper outer angle of the external ring.

6 The transversalis fascia of the weak spot in Hesselbach's triangle, at the lower part of the inguinal canal.

7 The palpable fibrous muscular edge of the external ring. Six or eight multiple injections are given here to make the ring fit snugly over the cord.



8 In direct hernia the internal ring is not involved, but I make a practice of giving two or three injections here because a direct hernia is almost always accompanied by a small empty congenital sac

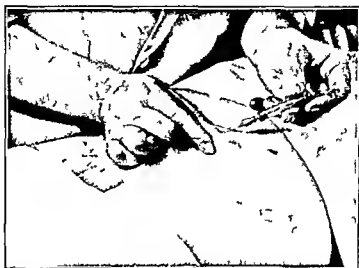


Fig 297—Bilateral recurrent postoperative inguinal hernia. Picking up the skin over the left internal ring at the site of injection so that the needle will not be inserted too deep with the first skin puncture



Fig 298—Bilateral recurrent postoperative inguinal hernia. The needle is pointed downward at an angle of 45 degrees to inject the internal inguinal ring

*Injections for direct hernia are not so deep as for indirect hernia. In the direct variety the needle is inserted at an angle of 90 degrees or at a right angle to the skin (Fig 296)*

Direct hernias require more injections than the indirect, because in the direct variety we do not have the aid of an oblique canal, and, in addition to

thus, the openings in the transversalis fascia and in the external ring are larger than are ordinarily found in the indirect variety. For these reasons ten to fifteen multiple injections are usually required to close a direct hernia.



Fig. 299—Bilateral recurrent postoperative inguinal hernia. Injecting the inguinal canal

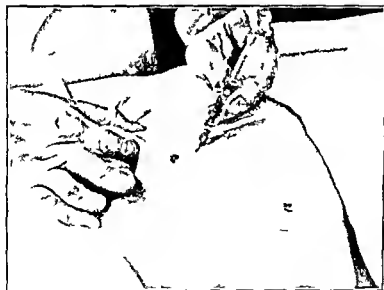


Fig. 300—Bilateral recurrent postoperative inguinal hernia. Injecting the external inguinal ring

**Recurrence Following Operation**—In spite of the numerous operations devised for the cure of inguinal hernia the percentage of recurrence remains too high. Indirect inguinal hernias usually recur through the opening left for the cord, occasionally they come through the deep suture line just above the pubis and rarely through the middle of the deep suture line or through a weak spot in the muscles or fascia.

Nearly all recurrent inguinal hernias are of the direct variety, and the injection treatment for them is the same as that for direct inguinal hernia. In addition any weak spot in the muscles or fascia should be properly reenforced by injection. As a rule postoperative hernias are easily cured by injection and they require fewer treatments than the usual direct hernias but perhaps more than the indirect variety. (Figs 297-302.)



Fig. 301.—B lateral recurrent postoperative inguinal hernia. Injecting Hesselbach's triangle.



Fig. 302.—B lateral recurrent postoperative inguinal hernia. Injection of Hesselbach's triangle on the right side.

### Dressing the Wound

The dressing for the needle puncture consists of a drop of tr. metarsen or tr. merthiolate or tr. metphen solution applied to the wound and a small

sterile square of adhesive plaster placed directly over the needle puncture a piece  $\frac{1}{4}$  inch square is large enough not to slip off. There is less soreness in the wound and the patient is more comfortable if a thick pad of absorbent cotton or soft felt is placed under the truss pad.

After the truss is readjusted the surgeon should place his right hand behind the patient's neck and assist him to sit up and get off the treatment table so there will be no strain on the site of the injection. This is especially important with obese patients.

### Bilateral Hernia

My records show that one third of indirect inguinal hernias and one half of direct hernias are bilateral or have relaxed rings.

I treat both sides at the same time or inject one hernia one day and at the next treatment inject the opposite side. If one hernia is larger I inject it three or four times before beginning to treat the smaller one. The same rule applies when the inguinal hernia is complicated by umbilical epigastric femoral or postoperative ventral hernias.

Patients who believe they have only a single hernia often complain of a "weakness" on the sound side. Examination will often disclose a potential or beginning hernia. This frequently happens after a unilateral hernia is cured by injection. The sense of strength and comfort on the cured side makes any weakness of the other side more noticeable.

### Length of Time Required for Cure of Hernia by Injection

The cure of hernia requires more time by means of the injection method than by operation. The improved painless solutions are responsible for the development of the multiple injection method which gives two to four injections through one skin puncture at each treatment. As little or no pain follows the injections treatments can be given two or three times a week at this rate curing the hernia in four to six weeks approximately the time required by the operation hospitalization and convalescence at home necessary before physical exercise.

Although the injection method may perhaps show the most uniformly good results when the treatments are given two or three times a week if the patient has a reason for wanting to accomplish his cure as quickly as possible or if he wants to take it in leisurely fashion there is no reason why the intervals of time elapsing between treatments should not be made to suit him. He can take a treatment every day, or one every week or two weeks thus the length of time for the injection method depends largely upon the wishes and convenience of the patient.

The period of time that the truss is worn following the injection treatment is hardly an indicator of the actual time required for the cure of the hernia because nowadays the truss or the abdominal binder is worn following operation also the length of time being from two to six months for both methods.

Patients taking the injection treatment have a way of dating the cure of their hernia from the last time it came down. I have been surprised at the number of patients who have said the third or fourth treatment marked their cure in this respect.

### Determining Sufficient Injections

The treatment is completed when all weak portions of the rings and inguinal canal have been closed by injection. Palpation gives a good idea of the amount of fibrosis that has been produced. With the patient standing I carefully



Fig 303.—Technique for injecting inguinal hernia. Reinforcing injection close to the inguinal ligament above the internal ring.



Fig 304.—Technique for injecting inguinal hernia. Reinforcing injections close to the inguinal ligament below the internal ring.

palpate the entire region of the hernia and if a little of the sac remains it can be felt as a small bulging soft spot that "pops" in and out when pressed by the finger, if the mass is larger, it gives when pressed by the hand.

Patients should not cough or strain to test the wound until the injections are completed and there is a broad firm area of induration around the rings and inguinal canal.

It is a well known fact that if two individuals have received the same number of injections and an equal quantity of the identical solution one will show a greater absorption of fibrous tissue than the other. After six or eight injections the patient should be examined in the standing position for remaining weak spots. This simple procedure will often cut down the number of injections required.

### Follow up Examination and Reenforcing Injections

After the usual number of injections have been given the patient continues to wear his truss for a while.

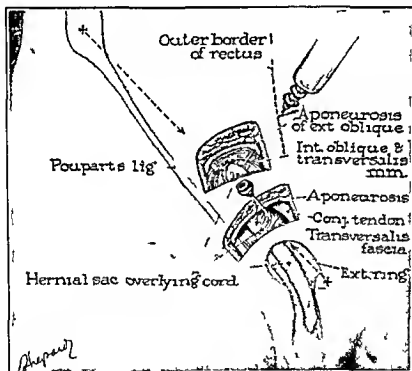


Fig. 305—Technique for injecting inguinal hernia. Showing the relation of the sac to the muscles and fascia.

For two or three months the groin should be examined every two weeks for possible weak spots that did not show up until the external ring was closed. If they appear they will probably be in the aponeurosis of the external oblique which overlies the inguinal canal and internal ring and very close to the inguinal ligament. Their presence in this location means that they are no doubt due to the tendency of many surgeons to place the injections too far inside of the inguinal ligament thus failing to inject part of the internal ring or the inguinal canal (Figs 303-305).

When there is a weak spot at the inner side of the external ring it means that probably a direct hernia accompanied an indirect one, but the direct hernia did not show up until the pressure of the indirect one was removed.

Patients with poor musculature especially if they are past fifty years of age, often show thin places in the muscles and fascia that are not noticeable until the bulging of the hernia is removed by treatment. For the same reason a cured patient often states that he has developed a hernia on the side supposed to be sound when the herniated side was being treated while as a matter of fact, there was a potential hernia there all the time. These weak spots cannot possibly be called recurrences because they have never been treated.

Overtreatment is better than undertreatment because the formation of fibrous tissue varies being greater in some individuals than in others under the same amount of solution and the same number of injections. This doubtless explains why recurrence sometimes develops after an operation that gave every indication of holding.

### Combined Operation and Injection

The injection can be used with the operation to good advantage in the following situations:

**1 Tendency to Recurrence**—For the postoperative hernia that shows a tendency to recur, a few properly placed injections will overcome the weakness that might develop into recurrence.

**2 Postoperative Recurrence**—The patient with recurrence hesitates to subject himself to the second operation. If the hernia is small it is often cured by a few injections.

**3 Prevention of Recurrence**—In large or direct inguinal hernias I make a routine of giving a few well placed prophylactic injections immediately after operation.

In all these conditions of muscle weakness or recurrence following operation the surgeon must insist that the patient wear a properly fitting truss for several weeks after the injections are completed.

If the hernia is low and cure is slow it is advisable to make a few injections into the femoral ring and to apply a femoral truss. There is always the chance of a mistaken diagnosis in obscure hernia. I have had patients who were mistakenly operated on for the wrong type of hernia in our largest clinics.

## CHAPTER XL

### INJECTION TREATMENT FOR FEMORAL HERNIA

The injection treatment for femoral hernia is more difficult than that for inguinal hernia. The treatment procedure described here is limited to femoral hernia.

Before injecting femoral hernia the chapters on the injection treatment of inguinal hernia should be read. The surgeon should be experienced in the injection of inguinal hernia before he attempts to inject femoral, as it is more complicated (Fig 306).

**Selection of Cases**—Small easily reducible femoral hernias are most suitable for the injection method. If the sac is large, special care is necessary to prevent accidental descent of the hernia and possible incarceration of the hernial contents. For this reason patients whose hernias are large or difficult to reduce should be in a hospital for the beginning of the treatment.

The patient is put to bed, the foot of the bed slightly elevated, and the hernia injected every day or two until the femoral ring is closed and the hernia no longer comes down. Then the patient is allowed to get up, and the injections are completed at the office as an ambulatory treatment.

**Contraindications to Injections**—The injection method supplements the operation for femoral hernia but does not replace it except in certain instances. The operation under local anesthesia is still the treatment of choice and is indicated in the following conditions:

- 1 Massive femoral hernias
- 2 Hernias with omental adhesions in the sac
- 3 Hernias difficult to reduce
- 4 Hernias with large femoral rings

**The Truss**—The patient must wear a properly fitted frame truss constantly, adjusted to make pressure over the femoral ring. It must hold the hernia reduced at all times and in any position he may assume in the course of his activities. For some patients a spring truss with a thigh strap is the safest to prevent the hernia accidentally slipping by the truss pad.

**Solutions**—The injection solutions are described under inguinal hernia. I use only the mildest sclerosing solutions for femoral hernia, preferring the procaine quinine phenol solution.

**Syringes and Needles**—I seldom inject more than 2 cc of solution at a single treatment, and I use a 2 cc Luer glass syringe with a 1 inch 22 gauge short bevel needle. The 2 cc syringe with needle attached is light easy to handle, and does not drag on the needle, consequently the needle moves less in the femoral canal than if a heavier syringe were used.

The short bevel needle spreads the tissues and is safer than a long bevel needle with its cutting edge and sharp point.

**Marking the Site of Injection**—I have found that marking the exact site where the needle puncture is to be made makes the injection safer and easier.



With the patient in the standing position ask him to cough or strain to distend the sac and with a skin pencil or soft diaughting pencil trace the outline of the hernia. Next place him on the table in a slight Trendelenburg position reduce the hernia and mark on the skin the location of the femoral ring. Again in the standing position draw a line from the upper limit of the femoral ring to the lowest point of the sac with the hernia reduced this line indicates the position of the empty femoral hernial sac. The injections should always be made along this line. Palpate the femoral artery and draw a line on the skin over the course of this artery and vein (Fig 307)

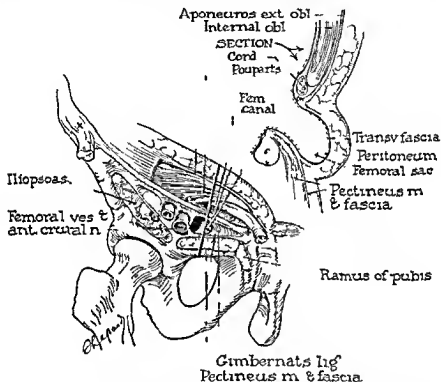


Fig 306—Anatomy of femoral region. Showing relation of femoral ring and vessels and the descent of femoral hernia.

**Position of the Patient on the Table**—The patient should be placed on the table in a slight Trendelenburg position so that the abdominal contents gravitate away from the femoral ring. The truss must be removed for the injection but only after the patient is lying down on the table it must be replaced immediately after the injection while he is still lying down.

#### Technique of the Injection

**Multiple Injections With One Syringe**—I use the procaine quinine phenol solution by the multiple injection method with a single syringe. Two or three injections of 0.5 cc each are given through one skin puncture into the femoral ring along the line connecting the femoral ring and the lowest limits of the sac.

I never use the strong sclerosing solutions in hernia, because there is too much danger of hernial incarceration if the hernia accidentally slips by the truss pad.

**Skin Puncture.**—Prepare the skin by shaving, and sterilize it with liquid soap and alcohol 10 per cent. Anesthetize a small spot at a point on the line which has been previously marked for the injection. Pick up the skin, with this point held between the thumb and the forefinger, and gently insert the needle, attached to the syringe containing the injection fluid, through the skin at the point selected for injection, which is the center of the anesthetized area.

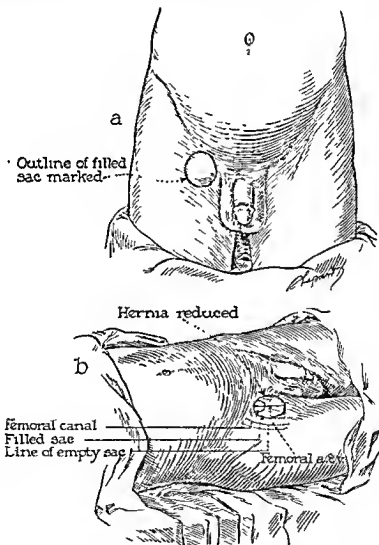


Fig. 307.—Method of outlining and marking femoral ring and hernial sac.

**Deep Injections and Safeguarding Femoral Vessels.**—The greatest care must be exercised to safeguard the femoral artery and vein against injury. The sheath of the femoral vein forms the outer boundary of the femoral ring. The artery lies immediately to the outer side of the vein.

With the needle inserted through the skin at the site of injection, the tip of the index finger of the free hand is placed firmly in the femoral canal and the femoral vessels are located and retracted outward. Pass the needle carefully downward and inward, toward the median line of the body and over the finger nail of the index finger, which remains in the femoral canal as a guide, until the point of the needle reaches the pectineus muscle and fascia.

### Multiple Injections With Single Syringe —

1 Aspirate the syringe, to make certain the needle is not in a blood vessel, then inject very slowly, 0.5 cc of the procaine quinine phenol solution

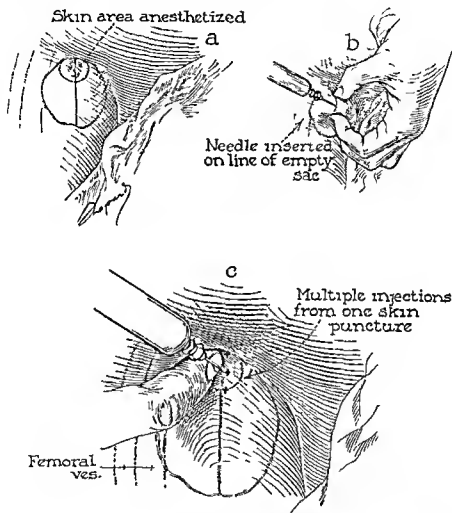


Fig 308 —Technique for injecting femoral hernia. *a*, Skin anesthesia at the side of injection *b*, Inserting the needle through the skin, *c*, method of multiple injections.

2 Withdraw the needle about halfway and move it to a point in the femoral canal  $\frac{1}{4}$  inch above the site of the first injection. Again aspirate, and inject as before, 0.5 cc of the solution

3 Finally make a third injection in the femoral canal  $\frac{1}{4}$  inch above the last one

The injections completed withdraw the needle and at the same time aspirate the syringe so that no solution will be left in the subcutaneous tissues or skin (Fig 308)

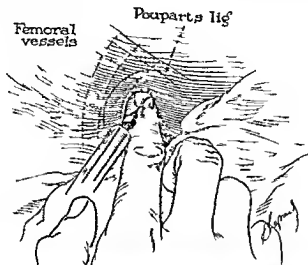


Fig 308—Technique for injecting femoral hernia. The needle pointed inward and upward slides over the finger nail into the femoral canal



Fig 310—The tip of the index finger in the femoral canal the femoral vessels located and retracted outward before the needle is passed over the finger nail into the femoral canal. The pubic tubercle and the anterior superior spine of the ilium are located and marked on the skin

**Amount of Injection Solution**—The amount of solution for injection depends primarily on the age weight and health of the patient the size of the hernia and the ease with which it reduces

There is a rule that the amount of solution for a femoral hernia should be one half the amount used for an inguinal hernia assuming that both hernias are similar in comparable respects. Probably the average quantity is 1 to 2 cc

**Angle of the Needle**—With the patient in the horizontal position on the table the needle is pointed downward and inward toward the median line of the body in the direction of the pectineus muscle and fascia which form the floor of the femoral canal. By pointing the needle in this direction it avoids the femoral vessels on the outside of the ring and the obturator artery which crosses the upper and inner margin of the ring in 10 per cent of all subjects (Figs 309 and 310.)

**Depth of Injections**—The distance from the overlying skin to the pectineal fascia is  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in the average subject in the obese it is greater depending on the subcutaneous fat in the groin.

For adults a one inch needle 22 gauge is the best length and for children a half inch needle is long enough. For safety's sake all needles should be of the short bevel type.

**Frequency of Injections**—Patients with femoral hernia are not treated as often as those with inguinal. I have found that a multiple injection treatment given every three to seven days is more satisfactory for femoral hernia.

It is important that the first three or four treatments are given at short periods of time to close the ring and prevent the hernia from coming down. This accomplished the remaining injections can be timed at close or leisurely intervals to suit the occupation or convenience of the patient.

**Number of Injections**—I have found that ordinarily six to ten treatments by the multiple injection method are sufficient for femoral hernia.

Elderly patients or those with large hernias require more than the usual number of injections just as those with small hernias need fewer sometimes only four or five multiple injections.

Nervous debilitated and frail patients should receive only one half the amount of solution ordinarily given in one injection as a result they require more than the usual number of injections.

**Determining Sufficient Injections**—The treatment is completed when the femoral ring is entirely closed the sac obliterated and no impulse is felt when the patient coughs. Palpation of the femoral region with the patient standing gives a good idea of the amount of new fibrous tissue produced in the femoral ring.

**Reinforcing Injections**—After the injections are concluded the femoral region should be examined once a month for a year in search of possible weak spots or recurrence in the femoral ring or near it.

**Truss Wearing**—The truss should be worn night and day during the period of treatment and for a month following the last injection. (See the rules for truss wearing in the chapter on the injection treatment for inguinal hernia.)

**Recurrence**—Patients who develop recurrence of femoral hernia after either the injection treatment or the operation can usually be cured quickly and easily by a few well placed injections in the femoral ring or femoral canal. Also they should return to their truss and wear it day and night for a month or two.

**Complications**—The injection of femoral hernia is more difficult than that for other varieties and the danger of complications is correspondingly greater.

Most of the complications and untoward results reported in the literature have been due to faulty technique to the use of caustic sclerosing solutions, to the injection of too much solution at a time, and to the slipping of the hernia under the truss pad after injection resulting in incarceration.

In elderly patients the iliac and femoral vessels are sometimes very superficial. This point should always be thought of when making the preliminary examination.

Edema of the leg and ankle may develop in the elderly as a result of too intensive treatment. It disappears after a few days' rest with the leg elevated if necessary.

The surgeon must carefully examine every femoral hernia so as to exclude that rare type of hernia that appears on the outer side of the femoral artery. This hernia must not be treated by injection.

## CHAPTER XLI

### INJECTION TREATMENT FOR UMBILICAL HERNIA

The injection treatment for the cure of small umbilical hernia is satisfactory in properly selected patients. Additional discussion on the injection treatment in general will be found in the chapters on the injection treatment of inguinal hernia.

**Selection of Cases**—Small easily reducible umbilical hernias are more quickly cured by the injection method than are inguinal hernias. The hernia must be freely reducible with no adhesions in the sac or at the margin of the hernial ring. The ring should not be more than 1.5 cm. in diameter.

Small umbilical hernia in infants, children, and adults usually respond to the injection. Infants and children are the more favorable subjects. I ordinarily give four to six injections at weekly intervals. In the meantime the patient wears an umbilical truss day and night until the treatment is completed. Bennett Jones in 1944 reported 42 infants and children between three months and five years of age with small umbilical hernia treated by the injection method. In 26 patients one injection effected a cure; in eleven patients two injections were required; and five patients received three or more injections.

**Contraindications to Injection**—The injection method is not suitable in the following conditions and operation is indicated:

- 1 Large umbilical hernias
- 2 Hernias difficult to reduce
- 3 Hernias complicated by intrascicular adhesions
- 4 Hernias in which the rings cannot be kept approximated by the truss
- 5 Obesity preventing palpation of the rings

**The Truss**—The patient must wear a properly fitted abdominal binder with a pad that holds the hernia reduced at all times and in any position he may assume in the course of his activities. This binder should be worn day and night during the period of treatment unless the hernia is easily retained when a light support may be substituted for the abdominal binder at night.

**Solutions, Syringes and Needles**—I have found the mild injection solutions satisfactory. There is very little postinjection discomfort from the procaine quinine phenol solution. I use a 5 cc Luer glass syringe and a short bevel needle 1 to 1½ inches long and 22 gauge.

**Marking Site for Injection**—With the patient standing outline the hernia with a skin pencil or soft diaughting pencil. Next with the patient lying down reduce the hernia and with the examining finger in the hernial ring trace the ring outline on the skin. The hernial opening is almost always just to the left of the midline. Outlining the hernia helps to locate any additional weak spots in the linea alba. (Fig. 311.)

**Position of Patient on Table**—The patient should be placed on the table in a slight Trendelenburg position so that the abdominal contents gravitate away from the umbilical ring.

The abdominal binder with hernial pad attached must be removed for the injection but only after the patient is lying down on the table it must be replaced immediately after the injection while he is still recumbent.

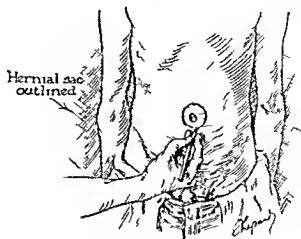


Fig 311—Method of outlining and marking umbilical ring and hernial sac.

### Technique for Injection

**Skin Puncture**—Prepare the skin by shaving and sterilize it with liquid soap and alcohol 10 per cent. Injections can be begun on either side of the hernial ring.

Select a site for the injection and anesthetize it with ethyl chlorid spray pick up the skin with this site held between the thumb and the forefinger. Gently insert the needle attached to the syringe containing the injection fluid through the skin at an angle of 45 degrees at the point of injection which should be about the center of anesthesia (Fig 312).

With the tip of the index finger in the hernial ring guide the needle into the firm fascia of the umbilical ring being careful that the needle does not enter the peritoneal cavity.

### Multiple Injections With Single Syringe—

1 Aspirate the syringe to make certain the needle is not in a blood vessel then inject very slowly 0.5 to 1 c.c. of the procaine-quinine phenol solution.

2 Withdraw the needle about halfway and move it  $\frac{1}{4}$  inch from the first puncture. Again aspirate and inject as before. Repeat this procedure until three to five injections have been placed in the fascial ring at appropriate intervals. One half of the ring can be treated at one time and the opposite half at the next treatment (Fig 313).

3 Should the peritoneal cavity be punctured accidentally injections should be stopped for that day.



4 After the injections are completed aspirate the syringe while withdrawing the needle so that no solution is left deposited in the subcutaneous tissues or skin

The length of time required for treatment is considerably shortened by the multiple injection method

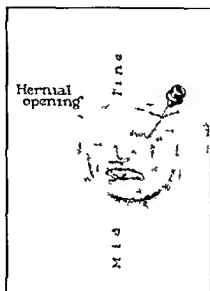


Fig 310—Injection of umbilical hernia. The needle is inserted at an angle of 45 degrees and injections are made into the fascia of the hernial ring

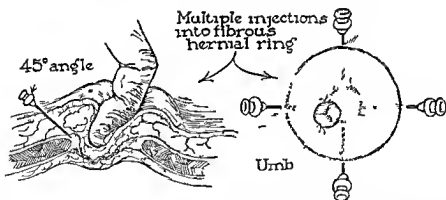


Fig 311 Technique for injecting umbilical hernia. Injections are made in the fascial ring at appropriate intervals

**Dressings**—After either method of injection the needle puncture is touched with a drop of antiseptic solution and a small square of sterile adhesive plaster placed over the wound. The truss is applied while the patient is still lying down and a pad of soft cotton or felt placed under the truss pad.

After a few minutes rest the patient is allowed to get up and resume his usual activities unless the hernia is large or there is some other complication to be provided for.

**Amount of Solution**—I inject 0.5 to 1 cc of procaine quinine phenol solution at three to five points in the fascial umbilical ring using the multiple injection technique giving all injections through a single skin puncture.

**Number of Injections**—If properly selected patients with umbilical hernia respond more quickly to the injection method than those with inguinal or femoral hernia. Four to six multiple injections usually effect a cure.

**Frequency of Injections**—Generally speaking the interval of time elapsing between treatments does not differ greatly in the varieties of hernia. Three to seven days however are preferable for umbilical hernia.

**Depth of Injections**—The sac often lies just beneath the skin so it is best to insert the needle an inch to the side of the hernia and with the aid of the examining finger direct it on an angle of 45 degrees into the fascial umbilical ring.

The best length in needles is 1 to 1½ inches for adults and ½ inch for children. With needles longer than these there is more danger of entering the peritoneal cavity.

**To Determine Sufficient Injections**—The treatment is completed when the umbilical ring is closed the sac obliterated and there is no palpable impulse when the patient coughs or strains. For some time the mass will remain as a small hard lump which gradually absorbs.

**Examination and Reenforcing Injections**—Recurrence is rare in umbilical hernia after the injection method. For six months following treatment patients should report monthly for examination.

If a bulging should develop in the cicatrix three or four injections will often correct the weakness. In elderly subjects it is common to discover additional weak spots close to the cured hernia especially in the linea alba.

**Complications**—There are not many complications of treatment associated with umbilical hernia. Care must be taken not to inject the solution into the abdominal cavity, if this accident should happen it is painful but not serious. More severe symptoms will result if the injection is made into a partially reduced hernia.

## CHAPTER XLII

### INJECTION TREATMENT FOR EPIGASTRIC AND VENTRAL HERNIA

The injection method can be recommended in appropriate cases for hernias in the linea alba (epigastric and hypogastric) and for small ventral hernias (postoperative or spontaneous) in any part of the abdominal wall.

**Selection of Cases**—Small easily reducible hernias are suitable for the injection method provided the edges of the ring can be held in approximation by a properly fitted truss. If the hernial ring is larger than 1.5 cm in diameter the injection method is contraindicated.

Epigastric and hypogastric hernias almost always can be treated by the injection method. If there is a small complicating peritoneal lipoma it does not always interfere with the success of the treatment because the little mass of fat is destroyed by the solution leaving only a small hard cicatrix.

Postoperative incisional hernias if small respond more rapidly to the injection method than inguinal hernia. These hernias developing after appendectomy are more amenable to the injection treatment than those in the gall bladder region or over the stomach.

**Contraindications to the Injection Method**—The injection is not suitable for the following conditions and the operation is to be preferred:

1. Hernias difficult to reduce
2. Those with intrascicular adhesions
3. Those with rings measuring more than 1.5 cm in diameter or smaller hernias whose edges cannot be approximated
4. The very obese patient
5. A postoperative hernia that has had drainage for suppuration should not be injected for at least six months after healing is complete.

**The Truss**—Epigastric and ventral hernias are retained best by a firm elastic truss with a large flat pad. If the patient complains that it is uncomfortable the pad can be fastened to a snugly fitted abdominal binder. It is usually a good plan to place a small pad previously fitted to the hernial opening on the inside of the large hernial pad.

**Solutions**—I use the mild solutions for epigastric and ventral hernias preferring procaine-quinine phenol solution.

**Syringes and Needles**—For small hernias I use a 2 cc Luer glass syringe and a 1 inch 22 gauge needle. A 5 cc syringe and a 1½ inch 19 gauge needle is best for large hernias and obese patients. The needle should be the short bevel type which spreads the tissues instead of cutting them and also minimizes the danger of entering the peritoneal cavity.

**Marking Outline of Hernia**—The injection procedure is safer and simpler to carry out if the hernial site is outlined with a soft draughting pencil or skin pencil with the patient in the standing position then with the patient lying

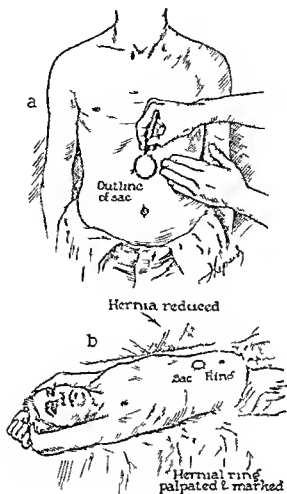


Fig 314.—Epigastric hernia. Method of outlining and marking the hernial ring and sac

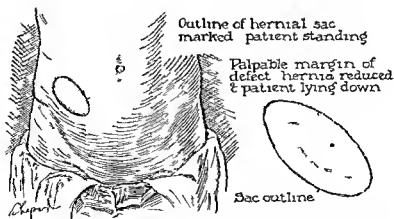


Fig 315.—Method of outlining and marking the hernial ring and sac in postoperative ventral hernia

down and the hernia reduced, the hernial ring can be traced. This plan of outlining is helpful in locating additional weak spots in the abdominal walls (Figs 314 and 315.)

**Position of Patient on Table**—The patient should be placed on the table in a slight Trendelenburg position, so that the abdominal contents will slip away from the hernial opening.

The truss or binder must always be removed for the injection with the patient lying down on the table, just as it must be applied while he is still recumbent after the injection is finished.

### Technique

**Skin Puncture**—Shave the skin and sterilize it with liquid soap and alcohol 10 per cent. With the index finger of the examining hand carefully palpate the margin of the ring to make certain there are no omental or intestinal adhesions in the mouth of the hernial sac. Injections on the right edge of the hernial ring seldom enter the peritoneal cavity.

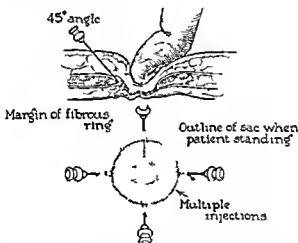


Fig 316.—Technique for injecting epigastric hernia. Small epigastric hernias can often be injected entirely around the ring with one needle puncture of the skin.

Choose a point for injection and spray with ethyl chlorid, grasp the skin with this point held between the thumb and the forefinger and insert the needle, attached to the syringe containing the injection fluid through the skin at an angle of 45 degrees at the point of injection, which should be about the center of anesthesia.

With the tip of the index finger as a guide direct the needle into the firm fascial and muscular margins of the hernial ring, being careful that the point does not enter the peritoneal cavity.

### Multiple Injections With Single Syringe—

1 Aspirate the syringe to make certain that the needle is not in a blood vessel, then inject very slowly, 0.5 cc to 1 cc of the procaine quinine phenol solution.

2. Withdraw the needle halfway and move it  $\frac{1}{4}$  inch from the first puncture. Again aspirate, inject as before, and repeat this procedure until three to five injections have been placed in the musculofascial ring at proper intervals.

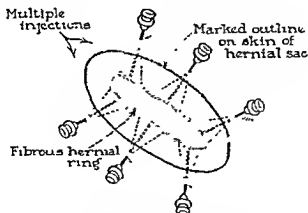


Fig. 317.—Technique for injecting postoperative or incisional ventral hernia. Showing the angle of needle and the sites of injection.

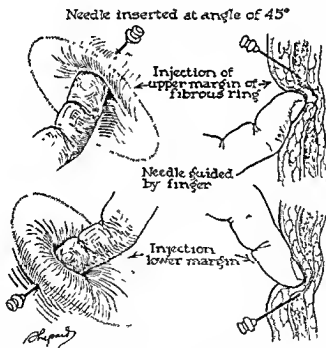


Fig. 318.—Technique for injecting postoperative or incisional ventral hernias, using the finger tip to guide the needle. Injections are made into the musculofascial ring at intervals of one-quarter inch around its circumference.

3. It is often possible to inject small epigastric hernias entirely around the ring at a single treatment. One-half of the ring of large incisional hernias can be treated at one time; and the opposite half at the next treatment. (Figs. 316-318.)

4. If the peritoneal cavity should accidentally be punctured, injections should be discontinued until the next time for treatment.

5 After the injections are completed aspirate the syringe as the needle is being withdrawn so that no solution is left in the subcutaneous tissues or skin. The irritating solution might cause fatty necrosis to develop or hard tender nodules that would interfere with the truss pressure.

**Dressings**—After either method of injection a drop of antiseptic is applied to the needle puncture and a small square of sterile adhesive plaster placed over the wound. The truss is applied while the patient is still lying down and a pad of soft cotton or felt placed under the truss pad.

**Amount of Solution**—I inject 0.5 of procaine quinine phenol solution at three to five points into the musculofascial ring by the multiple injection technique giving all injections through a single skin puncture.

**Number of Injections**—Small hernias in the linea alba (epigastric and hypogastric) are usually cured by eight to ten multiple injections. Small incisional hernias in the lower abdomen require ten to fifteen multiple injections while large hernias may need ten to twenty.

Incisional hernias in the upper abdomen require more treatment than those in the appendix region.

Spontaneous ventral hernias if small ordinarily respond to treatment more promptly than incisional hernias of similar size.

**Frequency of Injections**—Large ventral hernias can be injected every second or third day. Small ones especially the epigastric variety, usually do best with one injection a week.

For a further discussion on this subject see the injection treatment of inguinal hernia.

**Depth of Injection**—The sac of the hernia in the linea alba lies just beneath the skin and the ring is seldom more than an inch from the skin surface.

In incisional hernias the ring is often covered by a mass of fat and a needle  $1\frac{1}{2}$  to 2 inches long is required to reach the ring. The needle is inserted through the subcutaneous tissues at the side of the sac and angled at 45 degrees to the skin surface into the edge of the musculofibrous ring.

**To Determine Sufficient Injections**—The treatment is completed when the hernial ring has been closed and there is no impulse on coughing. Palpation is a reliable guide as to the amount of fibrous tissue in the ring. If a little of the hernia remains it can be felt as a small bulging soft spot that is easily pushed back with the patient standing. Patients should not cough to test the wound for some time after the treatments are finished.

**Examination and Reinforcing Injections**—The patient should report for examination once a month for six months after the last treatment.

Recurrence of small postoperative and epigastric hernias is infrequent after the injection method but when it develops it is easily cured by a few reinforcing injections.

Weak spots sometimes appear at the side of the original hernia in frail and aged patients. These weak spots can be strengthened by additional injections.

**Complications**—Great care must be taken to avoid the injection of solution into the abdominal cavity. Sometimes the overlying scars are very thin

If this accident should happen, the mild solutions may be expected to cause pain but no serious results unless the intestines have been punctured. The strong caustic solutions set up a severe reaction that may last several days.

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## CHAPTER XLIII

### INDUSTRIAL HERNIA

The industrial hernia problem is difficult for the physician or surgeon not experienced in industrial work to understand. Instead of being based on anatomical facts, the status of the hernia patient has been the subject of much social legislation. The problem and its solution represents a compromise between medical facts and public policy. The latter is dictated by political pressure groups, legal precedents, and humanitarian principles. For this reason, no attempt has been made to include the laws of the various states.

The rules and procedures of the different State Industrial Accident Commissions vary greatly. Some states do not pay for congenital hernia, others not only award an operation but also allow several weeks of disability compensation. When a referee awards an operation with compensation, it does not necessarily follow that he believes the hernia was due entirely to the man's work or accident. The referee is required to follow the statutes and decisions governing hernia in that particular state. Industrial hernia is probably the most frequent of the disabling frailties of the American workingman. It is estimated that 10 to 15 per cent of men in this group have an actual hernia, or a large ring, a potential hernia.

As a result of the establishment of state industrial commissions and compensation boards, the subject of traumatic and industrial hernia has become of great importance to all industrial organizations. Much confusion regarding the etiology of hernia is due to the use of the old word "rupture" (see chapter on general observations), and to the use of the term *traumatic hernia*, to describe occupational or industrial hernia.

#### Preemployment Examination

It is generally recognized that the working capacity of the man with a complete hernia is reduced 25 to 75 per cent, depending on his age and the satisfactory control of the hernia by a truss under his usual working conditions. *Elderly patients suffer more pain and discomfort from hernia than younger people and are more subject to attacks of colicky pain and strangulation.* The middle aged man who has been in the same employment for years probably was not examined when he secured his position. If he was examined and had a hernia then, perhaps it was small and not noticed by the medical examiner, because rules were lax on preemployment examination until recent years.

The importance of a physical examination of all employees before they are hired cannot be too strongly emphasized, and it is the most effective means of lessening the number of cases of alleged traumatic or accidental hernia. Hopkins stated that, of all the men who passed a physical examination before entering the railroad service, the claim of traumatic hernia was less than 1 per

cent while 91 per cent of the cases of alleged traumatic hernia were in those who were employed without a preliminary physical examination (Greeks Italians and Poles) Colecord pointed out that foreign laborers become prematurely old at forty to forty five years and after this age hernia is much more liable to occur than in young men of good musculature

The value of preemployment examination is well illustrated in the studies of McGill in 1945 who compared two groups of shipyard workers each group having over 100 000 men on payroll There were over three times as many hernia and nearly three times as many serious cases in the yards not requiring preplacement examination as in those shipbuilding companies requiring pre employment physical examinations Stephens remarks that if the employer is to be held responsible for the development of hernia in his employees during the time of their employment he has a right to insist on a preplacement physical examination

Gardner in 1941 analyzed a group of 24 934 examinations for employment and concluded that the civil employee with relaxed rings is twice as liable to develop hernia as the patient with normal rings Nilsson in 1937 reported that in the course of 7 967 examinations of railway employees 760 hernia were found Johnston in 1940 stated that the Ohio State Industrial Commission found 17.5 per cent of recurrence after operation for inguinal hernia For this reason the worker who has had an operation should be examined every three months for the first two years Metz in 1940 made a careful survey of 12 300 men who were working and found 6.4 per cent had hernia 7.6 per cent had large inguinal rings potential hernia and 1 per cent had had inguinal hernia operations Acuff has made a study of disability and operation

Armentrout in a group of 1 837 workers found 4.9 per cent of hernia Sutelan concludes that in times of manpower shortage as during a war men with hernia can be employed temporarily with comparative safety

**Examination for Hernia**—The examination for hernia should be thorough and painstaking and is best carried out by a surgeon who specializes in industrial surgery This is preferably done by following a regular routine a careful history of the onset and progress of the hernia its alleged cause the degree of disability and pain immediately following the onset the names of witnesses of the alleged accident the time it was reported and how soon the lump was noticed and under what circumstances

**Physical Examination**—Most states require that the patient remove all of his clothing below the waist and the inguinal region Small and potential hernias are discovered with the patient in the standing position in a good light while he strains or coughs with the legs wide apart Have him shift from an upright to a stooping or forward bending position The size and position of the testis and spermatic cord should be noted and recorded Previous operations truss pressure varicocele or venereal infection may account for atrophy of the testis and cord The latter is usually larger on the affected side Careful inspection of the pubic hair over each groin may give evidence of prior truss wearing in claims for alleged recent injury The hairs will be thinned out and shorter from the pressure of a truss pad Ritter points out that it is not unusual for

the applicant to take a long hot bath the evening before the examination so as to hide the truss marks on the abdomen and brief

It is of equal importance to examine the patient in the recumbent position especially if it is difficult to decide whether the hernia is direct or indirect. In this position the size and condition of the external inguinal rings can be determined and the floor of the inguinal canal can be explored and Hesselbach's triangle examined. In postoperative recurrent hernia the point of exit of the new hernia can be accurately determined. The presence of hydrocele, a tumor or lump in the hernia sac, cord, epididymis or testis should be noted.

Colecord also stated that applicants who have a congenital open external ring with firm muscles and aponeuroses protecting the inguinal region run very little risk of a future hernia, while those with patulous external and internal rings and lax surrounding tissues are liable to develop hernia and should be rejected. In examining for patulous rings and concealed hernia (in addition to the symptoms and signs described in the chapter on inguinal hernia) the skin should be carefully inspected for evidence of previous truss wearing. The rings should be examined while the patient lifts a heavy object and at the same time coughs. A normal canal grips the finger when the patient coughs and the internal ring cannot be felt. Weakness in the triangle of Hesselbach should also be looked for.

**Frequency of Potential Hernia and Relaxed Inguinal Rings.**—Industrial and railroad corporations requiring physical examination of employees refuse any applicant with relaxed inguinal rings. If an individual with such weakness was employed by a firm or an employer not exacting physical examination, he is liable to be dismissed at any time that such physical examination is enforced.

If a man with relaxed inguinal rings is required to do heavy manual labor there is danger that omentum may enter the empty congenital sac.

There is a large group of individuals with relaxed inguinal rings who are almost certain to develop hernia some time in their lives. The operative treatment offers them a preventive means of cure and assures them against loss of their place in industry.

**Frequency of Open Rings and Hernia.**—Colecord sent out questionnaires to surgeons in industrial surgery. One hundred answers covering about 500,000 examinations were complete enough to be of value. The more important answers were summarized as follows: 20 per cent of the surgeons examined applicants for hernia before employment. Of those examined 10 per cent had open inguinal rings and 2 per cent had hernia. Twenty per cent of the surgeons who replied believed that every open ring was a potential hernia and 90 per cent of them believed hernia was due to a congenital defect. Only 2 or 3 cases of traumatic hernia were reported.

Colecord examined 9,000 men and found 784 (8.7 per cent) open rings and 153 (1.7 per cent) hernias. Of 24 patients who subsequently developed hernia only 3 had open rings at the time of the preliminary examination. 3 of the 784 patients with open rings later developed hernia.

**Diagnosis of Industrial Hernia.**—An external ring twice the size of an adult male's index finger, along with loss of tone of the ring structures is un-

questionably a relaxed ring. When an impulse is felt as the patient coughs and continues as the finger is slowly withdrawn it is evident that a congenital hernial sac exists.

Moorhead groups industrial inguinal hernias follows

First degree hernia External ring admits tip of index finger

Second degree hernia Admits tip of index finger also gaping external ring and an impulse on coughing

Third degree hernia Admits tip of index finger, impulse and lump at external ring

Fourth degree hernia In addition to gaping ring and impulse the hernial mass has descended below the external ring often into the scrotum

### Summary of Differential Diagnosis of Direct and Indirect Hernia —

1 Point of bulging Indirect hernia appears over the inguinal canal. Direct hernia is near the pubic spine

2 Size of hernia Direct hernia presents oval domed or square shape with broad base. Indirect hernia presents fingerlike sac through inguinal canal and rings it is often in the scrotum in the form of a large mass with a narrow neck

3 Reducibility Indirect are frequently irreducible. Direct almost never strangulate. Direct hernias reduce quickly on reclining. Indirect recede slowly often with difficulty

4 Irreducible Direct hernias very rarely are irreducible or strangulate. Indirect hernias if large are at times irreducible and occasionally strangulate

5 Bilateral hernias are usually direct. Unilateral type are nearly always indirect

6 Direct hernia are very rare in women and children and are infrequent in men under twenty years of age

**Length of the Inguinal Ligament**—The length of the inguinal ligament has a direct relationship to direct and indirect hernia. Harris and White state there is little tendency to hernia formation when the inguinal ligament measures less than  $4\frac{1}{4}$  inches (11 cm.) hernia is probably indirect when  $4\frac{1}{4}$  to 6 inches (11 to 15 cm.) and nearly always direct when 6 to  $7\frac{1}{4}$  inches (15 to 19 cm.) the mixed types appear when the measurement approaches 6 inches (15 cm.)

**True Traumatic Hernia**—True traumatic hernia is very rare and only a few cases have been reported in the literature. This hernia is due to an injury that tears the tissues by a crushing blow, a fall from a height or a laceration of the structures by a sharp instrument.

Selly reported an unusual case of direct abdominal hernia in a man who fell from a scaffold and was struck by a wheelbarrow handle in the right iliac region. He complained of very severe pain and the skin was slightly abraded but not discolored. Operation disclosed breaks through the aponeurosis of the external oblique, the internal oblique and transversalis muscles. The rupture of the aponeurosis was in the direction of its fibers and as clean cut as if it had been made with a knife. Cases of true traumatic hernia have also been reported by Mock in 1919, Ehrlt in 1939, McWhorter in 1939, Maxeiner and Hoffert in 1939 and Meade and Murray in 1940.

A true traumatic hernia is a rarity. There is probably not more than one in 10 000. The 9 999 are occupational and not traumatic.

**Occupational or Industrial Hernia**—Occupational hernia constitutes over 99 per cent of all the hernias that come before state industrial commissions to be considered from a medicolegal aspect. Occupational hernia is due to a sudden or gradual increase in intraabdominal tension which may be caused by a fall from a height, a misstep or slipping, hard manual labor, a sudden strain, coughing, sneezing, whooping cough, etc. As a result of such effort there is a descent of abdominal viscera, usually omentum, intestine, or both, into a preformed sac (Fig. 319).

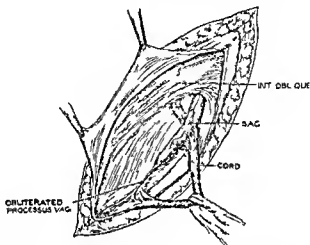


Fig. 319.—Typical empty congenital hernial sac such as is found in industrial hernias.

It is generally agreed that by far the most important cause of all varieties of hernia is the presence of a congenital sac or peritoneal diverticulum at the hernial orifice or in the canal. (The active and predisposing causes of congenital hernia have been considered in detail in the special chapters, particularly in those on inguinal and femoral hernias.) Nearly all industrial hernias are inguinal; consequently they overshadow in importance all other varieties put together. The usual predisposing causes of inguinal hernia are an anatomic weakness and a congenital preformed sac when combined with a common exciting cause such as a sudden or prolonged strain. These are etiologic factors that lend themselves admirably to legal controversy (Fig. 320).

While the congenital theory of the origin of inguinal hernia is generally recognized by the courts as well as the industrial boards have not always accepted it. This attitude is based on the long line of English court decisions that excessive strain must be regarded as an injury. The courts do not always accept the views of surgeons and anatomists, and the law is based largely on precedent decisions in similar cases. Wainwright has recently summarized the literature on the congenital sac theory with especial regard to its relation to workmen's compensation laws. Ribeiro has discussed the laws of Brazil.

Colcord believed that the abdominal wall is weakened and occupational hernia predisposed to by hard labor, excessive drinking, poor food, faulty hygienic homes and muls, heredity, tuberculosis, and syphilis. Plummer stated that the importance of pressure from lipomas in the inguinal canal is of more importance than is generally supposed.

Dr T E P Gocher, of the Aetna Insurance Company, has called attention to a back groin complex in hernia which he believes is due to injury of the disc of certain vertebrae, especially those between the tenth dorsal and the third lumbar. He is of the opinion "that in cases where there is an excitability

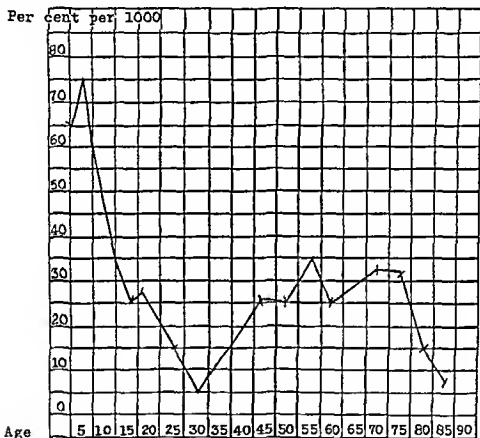


Fig 320.—Bécker's chart showing the frequency of hernia at different ages based on an examination of 16 000 subjects

of the sympathetic nerve cord or ganglia in this region, that a sudden jarring may cause a referred pain to the inguinal canal. It is also possible that an injury to the groin or the canal may cause a reflexed pain referred to these already irritable sympathetic cords. I do not believe that this latter would occur in a normal state of the sympathetic nervous system. I have also found that where a disc injury did occur, there is always pain on axial pressure down the spine, when pressure is applied to either the shoulders or the top of the head. If no pain is elicited by this pressure, then I would not consider that any disc injury or irritation was present."



**Microscopical Examination of the Sac**—Microscopical examination of a hernial sac shows that it consists of a thin lining of endothelium lying on a thick layer of dense fibrous tissue.

Hertzler remarks that one of the strongest evidences of the sac being preformed is afforded by an examination of the connective tissue at the point of union of the sac and cord. Microscopical examination will show an interlacement of fibrils running parallel to the walls of the sac and continuing over the cord, but separated entirely from other surrounding tissue. In several hernias of less than five days' duration microscopical examination showed that the union of the sac to the cord was made up of fully developed fibrous tissue, free from cellular infiltration.

**The Internal Inguinal Ring**—The internal ring is generally neglected because of its deep location and difficulty of examination. It plays an important role in industrial hernia since a congenital sac must pass the internal ring before it can enter the inguinal canal. Lytle points out the importance of the internal inguinal ring. On account of its mobility it is an important factor in guarding the entrance to the inguinal canal. The repair of this mechanism when at fault is an important step in restoring the canal to normal.

**Pain in Industrial Hernia**—The industrial commissions and the courts in general have ruled that the pain must be referable to a definite time, place, and circumstance, and the pain must accompany the accidental injury. A tired feeling, exhaustion, and fatigue do not come under the heading of pain. The latter must express a definite degree of distress or suffering, contradistinguished from normal fatigue. Pain is usually present if the empty sac fills quickly, as in the case of a severe injury, fall, or strain. On the other hand, if the hernial mass or lump descends slowly and hails temporarily at the external ring, there will be no history of pain. When the lump first appears, the patient is surprised and immediately looks back to some specific act as a cause of the hernia, such as a twist, strain, slip, fall, or the lifting of an unusually heavy object.

**Rupture of Intestine From Muscle Strain**—Excessive or severe abdominal muscle strain rarely produces a rupture of the intestine unless accompanied by traumatic injury to the abdominal wall. Berman and Rosner in 1942 reported the case of a man who, while lifting a 200 pound monument stone, felt a sudden severe abdominal pain. Operation disclosed rupture of the intestine. The man recovered.

Wilensky and Kaufman in 1937 reviewed the literature and wrote at length on the etiology, diagnosis, and treatment. In 43 cases the time of operation and mortality rate was as follows:

TIME INTERVAL BEFORE OPERATION	CASES	DEATHS	PER CENT
0-12 hours	15	6	40
13-24 hours	7	5	71
25 hours or later	13	11	84
Unoperated	4	4	100
Interval not stated (presumably promptly)	2	0	0
Outcome not stated	2		

**Measures to Lessen the Occurrence of Hernia**—In the act of lifting, employees should be instructed to use the leg muscles and not the abdominal muscles. A wide stance is dangerous, and the arms should be outside of the knees when lifting weights. The feet should be placed firmly on the floor or ground, as many accidents are due to the foot slipping while lifting. Tugman urges the more general use of mechanical lifting aids in factories.

**Aggravation of a Preexisting Hernia**—Proof of the activation, accentuation, or aggravation of a preexisting hernia is recognized by several states. This is in accord with the English law that states, 'where a strain causes protrusion of the bowels it is a compensable injury even though the protrusion is at a point weakened by congenital malformation or preexisting hernia.'

**Congenital Hernia With No Aggravation**—As a rule, there is no aggravation of a preexisting hernia under the following conditions:

- 1 If the hernia is the size of a hen's egg when first reported
- 2 If the hernia did not cause immediate pain and discomfort
- 3 If the individual did not fall or strike something
- 4 If he did not stop work at once
- 5 If he did not report the discovery of his hernia immediately after the alleged accident or consult a physician

#### **Conditions Warranting the Probability of Aggravation—**

- 1 The patient should know exactly when and where the accident occurred and must report it immediately
- 2 The accident can take the form of physical exertion, direct or indirect force or impact
- 3 The patient must experience pain in the affected region at once, and it must be sufficiently severe to force him to stop work immediately. The pain is usually temporary
- 4 A hernial mass or lump must be discovered immediately after the alleged injury

#### **Signs and Symptoms Indicating the Existence of Hernia Previous to Accident.—**

- 1 Thinning of the fat pad over the external ring on the affected side caused by pressure of the truss, there may even be a depression over the inguinal region outlining the position of the truss pad and the pubic hair is worn short by friction
- 2 Relaxed inguinal rings on both sides
- 3 The existence of scrotal hernias, especially if difficult to reduce
- 4 The failure of the patient to remember the date or hour of the alleged accident.
- 5 The absence of pain at the time of the alleged accident and the patient did not stop work
- 6 The neglect of the patient to report the discovery of his hernia promptly
- 7 The presence of a hernia or an operation scar in the uninjured groin
- 8 A history of vague pain and discomfort in the affected groin prior to the alleged accident often indicates the existence of a beginning hernia

9 Hernia or open ring on the sound side or at one of the other abdominal openings

10 A family history of hernia, or history of hernia or hydrocele in childhood

### Differential Diagnosis

A number of conditions may be mistaken for hernia (The differential diagnosis is fully dealt with in the special chapters)

Germany (1884) was the first country to pass a workmen's compensation act Austria Switzerland, Denmark, Norway, England, and other countries soon followed with similar laws, and at the present time in the United States such laws are in force in a majority of the states

The Illinois Industrial Commission rules An injured employee, to be entitled to compensation for hernia, must prove

- 1 That the hernia was of recent origin
- 2 That its appearance was accompanied by pain
- 3 That it was immediately preceded by trauma arising out of and in the course of the employment
- 4 That the hernia did not exist prior to the injury

The German courts have held that traumatic hernia is subject to the following conditions

- 1 The relationship between the accident and the hernia must be proved by an examination made within forty eight hours
- 2 It must be proved that the hernia appeared suddenly
- 3 It must appear immediately after the accident and be accompanied by pain
- 4 Proof must be furnished that the hernia did not exist prior to the accident

The indemnity awarded by German courts has usually been reduced on proof that a congenital or acquired predisposition existed before the accident

The Swiss courts define the following rules for compensable hernia

- 1 The hernia must appear suddenly
- 2 It must be of recent origin
- 3 It must be accompanied by pain
- 4 It must immediately follow an accident
- 5 It must be proved that the hernia did not exist prior to the accident

The Swiss law awards damages in proportion to the predisposition proved

The French courts have ruled that there exists "evidence of the relationship between the work performed by the laborer and the manifestation of the hernia" Dedoménil stated the Argentine courts allow 12 per cent disability for hernia

The French courts have ruled that traumatic and accidental hernias are compensable but the hernias of weakness are not

The California and Nevada State Industrial Commissions were among the first to rule that industrial hernias are almost always due to the presence of a preformed sac

*The California Industrial Commission rules*

"The consensus of medical and surgical opinion runs to the effect that hernia is very rarely, in any proper sense, the result of an accidental injury, that the accident at best is no more than the occasion, instead of the cause of the malady, that the origin of the difficulty is congenital and more in the nature of a disease than an injury, that every claim for compensation based upon an alleged rupture is to be viewed with suspicion "

*The Nevada Industrial Commission rules*

"Medical science teaches now what it has taught for the past twenty years and is now accepted as a medical and scientific truth, corroborated as such by the foremost surgeons and anatomists in the world, that is, that hernia, or so called rupture, is a disease ordinarily developing gradually, and is very rarely the result of accident "

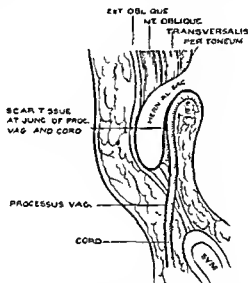


Fig 321.—Congenital inguinal hernia. Showing the close relationship of the hernial sac and the spermatic cord.

While an accident or strain often first calls the patient's attention to the condition, it must be remembered that a single strain or injury causing increased intraabdominal pressure, cannot produce a hernia unless there is a preformed peritoneal sac to receive the omentum or intestine. The descent of omentum or intestine into a small empty peritoneal pouch or potential sac is often accompanied by slight pain.

Recent industrial hernias are not accompanied by ecchymosis of the skin, and they are not painful or tender to the touch. A careful examination of the sac, rings, and canal at operation will furnish conclusive proof of the duration of the hernia. A thick, tough sac firmly adherent to the cord or other surrounding structures, and large hernial rings are evidence that the hernial sac has been present for years, and part of it since birth (Fig 321). Some patients honestly believe the strain was the cause of their hernia, others know they had a hernia, and it is not uncommon for them to seize the occasion of the strain

or injury as a means of getting some 'easy money,' with the aid of an eloquent attorney to sway a sympathetic jury

A strain alone cannot produce a hernia. This is proved by the fact that severe trauma such as a fall or crushing injury may cause fatal internal injuries rupture of the bladder stomach intestine diaphragm liver kidney or spleen without producing an inguinal hernia provided the processus vaginalis has been completely obliterated. An examination of the external inguinal fossa during the course of an abdominal operation is sufficient to convince the surgeon of the strength of these structures and of the fact that all the pressure that can be exerted with the examining finger is not sufficient to force a passage through the internal ring. In fact it is much easier to produce a hernia by entering the external ring and then dilating the inguinal canal and internal ring. (See artificial hernia.)

It is evident that a single strain no matter how violent is incapable of producing a hernia without tearing the muscles and fasciae causing subcutaneous or peritoneal hemorrhage and swelling and ecchymosis of the skin over the hernia. In true traumatic hernia there is no scar the hernia usually being of the ventral variety. It is very rare for the hernia to come through at one of the hernial openings.

### Recommendations in Industrial Hernia

The recommendations of the Special Committee of the Medical Section of the American Railway Association are as follows:

1. Render proper compensation for all cases of true traumatic hernia due to direct violence. Such cases are so few in number as to be practically negligible.

2. Make a physical examination of all applicants in industry no matter in what capacity. Such examinations will determine the fact whether or not a hernia was present at the time of examination.

3. Any hernia developing in the course of duty incident to the man's daily work should be treated as a disease due to special anatomical weakness on the part of the individual for which the company is in no way responsible. If it is considered wise under certain circumstances to recognize any moral responsibility let it be on an economic or humane basis. This moral obligation should be understood to be strictly limited to such employees who had been found apparently free from hernia at the time of previous physical examination.

The New York Compensation Commission is rather inclined to take the view that hernia is not generally the result of trauma yet there was an unwritten rule established that if the employer offered a correcting operation and it was refused an award would be made for eight weeks' disability and the case closed."

### Cause of Congenital Indirect Inguinal Hernia

The State Industrial Commissions have been slow to accept the scientific facts that have been established as the cause of hernia by surgeons who have devoted the most study to this work.

Contrary to the general opinion, congenital inguinal hernia is not often symptomless. There are immediate definite symptoms that accompany the descent of a mass of omentum or a knuckle of intestine into an empty hernial sac. There is a sharp pain over the hernia, a feeling of faintness and nausea—all due to irritation of the sensitive peritoneum. The subject often stops work and when he examines himself some time later he probably finds a lump the size of a small hen's egg which pushes back easily, stopping the pain.

The empty hernia sac is thinner than tissue paper, and extremely sensitive as it has an abundant nerve supply. When it is irritated by the presence of a tenant the symptoms resemble a mild peritonitis until the sac becomes thickened and adjusts itself to its occupant. The sac being intimately adherent to the vas deferens causes the pain to radiate down the cord to the testicle. All these subjective symptoms can be reproduced at operation under local anesthesia if an empty congenital hernial sac that has never had a tenant is opened and picked with gauze and then friction made on it.

Nothing is more erroneous than the general belief among some physicians and the laity that muscular effort is the cause of hernia. The popular idea of the *modus operandi* is that a sudden or long continued muscular effort in some unexplainable manner causes a pressure on the abdominal contents and this in turn forces a knuckle or loop of intestine to make a passage through the solid abdominal wall regardless of the intricate network of muscles and fascia effectively arranged to prevent just such an accident. How any one can seriously believe that a soft velvety collapsed coil of intestine can suddenly assume the hardness of a cold chisel and accomplish something the human finger cannot do is beyond my comprehension. It is a well known fact that the finger cannot be forced through the internal inguinal ring if there is no empty sac opening into the abdominal cavity.

In postoperative ventral hernia a large fully developed sac never appears suddenly; the peritoneum must be subjected to weeks or months of continuous stretching before a sac is formed and yet the muscular protection over the inguinal canal is many times stronger than that over a thin abdominal scar.

If simple increase in intraabdominal pressure could cause hernias we would all have them and they certainly would appear at the weakest points in the abdominal wall and not at the strongest—the inguinal opening. The opening in the diaphragm for the esophagus is an ideal weak point where hernias should frequently appear but they do not. The femoral ring is the weakest spot in the lower abdominal wall—a large ring with rigid walls and no muscles to guard it—yet hernia here is rare in men.

In spite of the popular notion the inguinal canal is not weak. It is so powerfully constricted that if there is no patent processus vaginalis waiting for a tenant it is impossible to produce an indirect inguinal hernia no matter how much force is exerted by lifting, straining or any other form of violent effort. The semispincteric fibers of the internal oblique exert a lifting power which is called into play during increased intraabdominal pressure and this brings into action a corresponding amount of resistance over the inguinal canal (Fig. 322). Keith pointed out the shutter action of the muscles surrounding the

inguinal canal and described the mechanism whereby the muscles contract and close the canal to counteract intraabdominal pressure from above

Once the internal ring relaxes or enlarges, and a tongue or wedge shaped piece of omentum gains an entrance, it is an easy matter for the mass to dilate the internal ring to a point where it has no ability to come back or regain its tone, and the protection of the semispincter action of the internal oblique and transversalis muscles and the inguinal ligament is lost. Once past the internal ring, the hernia rapidly dilates the inguinal canal on its way to the external ring.

In 1817, Cloquet, a French anatomist, in the course of 500 dissections found a depression of the lower border of the internal ring with more or less bulging of the peritoneum. He called this "the infundibuliform process," and found it so often that he thought it a normal condition! We now know that he found an open processus vaginalis or sac.

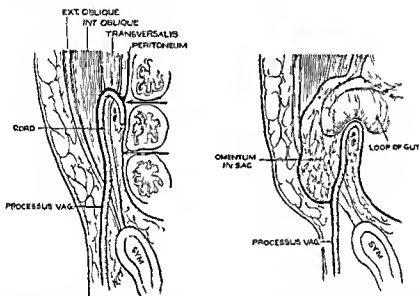


Fig 322 —A, Showing the obliquity of the normal inguinal canal and how intraabdominal pressure forces the walls together

B Showing the ease with which omentum and intestines enter an empty sac when the internal ring dilates and destroys the obliquity of the inguinal canal

The obliteration of the processus vaginalis is best studied during hernia operations on infants and children. When the processus vaginalis is obliterated only in its lower half or two thirds, it is easy to find a well marked fibrous cord springing from the fundus of the sac at its lowest point. This cord can be traced down in the spermatic structures to the tunica vaginalis testis. Sometimes this obliterated portion of the processus vaginalis resembles the tail of a kite, often a well defined mass of scar tissue is the dividing line between the open and the obliterated portion of the processus vaginalis.

The congenital origin of indirect inguinal hernia is shown by the uniform arrangement of the vas and blood vessels in relation to the sac, the vas is always to the inner side and firmly adherent to the sac, regardless of the

recentness of the discovery of the hernia. The vessels are always behind the sac and separated by an interval from the vas. Small sacs lie right in the heart of the spermatic cord—a strange location for an “acquired” hernial sac. At the same time the highly organized tissues and delicate blood vessels over the sac and in the cord show no evidence of a sudden descent of a hernial sac. Nothing but a preformed sac can explain a hernia that protrudes to the external ring on its first appearance. Peritoneum requires weeks or months for stretching.

Gillespie emphasized the fact that the ordinary indirect inguinal hernia is the result of a predisposing cause, a preformed sac along with a series of stresses and strains involving increased intraabdominal pressure. Stone remarked that the only effect of exertion is to make evident a defect that already existed.

The present opinion is that except for the rare cases of traumatic hernia, all indirect inguinal hernias are congenital in origin, regardless of the age of the subject when the hernia was first discovered. The presence of empty congenital sacs in adults is more common than is generally supposed. A majority of men undoubtedly carry these potential hernial sacs throughout life without evidence of hernia. Microscopic examination of the sac fails to show any difference between old and so-called new sacs.

Nothing but the congenital origin of indirect inguinal hernia will explain why a sac will be found on the supposedly sound side in 75 per cent of the patients subjected to bilateral operation.

### True Traumatic Hernia

A true traumatic hernia presents a very different picture. In the first place a traumatic hernia is practically never found at the inguinal or femoral opening, but at a point on the abdomen or chest where the blow has been inflicted, usually by something sharp or pointed, such as a wagon pole, iron bar, picket, or a hull's horn. The man falls in agony and cannot rise. His face is pallid, anxious and drawn with extreme pain, or else he is unconscious. The pulse is feeble and thready, the temperature subnormal, and there are all the symptoms of profound shock and collapse. There are often ruptured abdominal viscera, and sometimes broken bones. If the injury has not torn a gap in the abdominal wall, there will be evidence of subcutaneous hemorrhage and laceration of tissues. The hernia is usually small, very painful and irreducible, except by taxis and it has no sac. If the patient can live until the physician reaches him, and treatment can be administered without moving him too great a distance, he may possibly recover.

A case was reported to me of a man who was struck by a wagon pole in the lower abdomen just below the umbilicus. The skin, fascia, and muscles were torn apart, and coils of intestine were lying outside on the abdomen when the doctor arrived, which was almost immediately. After he reduced the intestines, the hernial opening was large enough to admit his hand easily. He sewed up the wound the best he could, and the man recovered. Calist reported a rare case of traumatic hernia following a crushing injury of the scrotum with ex-



trusion of the testis. Burk reported the case of a man with traumatic femoral hernia following a severe strain due to sudden shifting of weight. The man collapsed, and operation disclosed an extensive hemorrhage in the hernial sac.

A true traumatic hernia is a rarity. There is probably not more than one in 10,000. The 9,999 are not traumatic. (Fig. 323.)

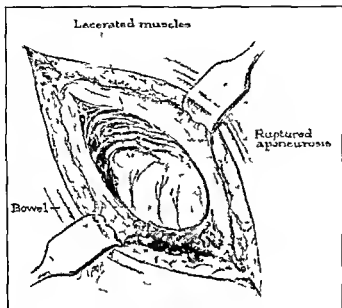


Fig. 323—A true traumatic hernia with laceration of muscles and fascia and subcutaneous hemorrhage.

### Cost of Treatment and Compensation

The cost of hernia to industry is high. It varies in different states depending on the laws covering hernia. The amount paid out is considerable in the large industrial centers, for example, McNealy stated that in 1941, the Illinois Industrial Accident Commission handled 1,515 cases of hernia at a cost of \$211,441 and 15,452 weeks of disability. Palmer pointed out the saving that follows the treatment of selected and favorable cases by the injection method without any loss of time from work.

### Early Rising After Operation

Early rising is recommended for nearly all patients after hernia operations. Allen stated that early risers returned to strenuous work within four weeks while those who were in bed ten to fourteen days required two to three months to get back to work.

### Death Rate From Hernia

It is not generally realized that hernia holds an important place in the nation's mortality rate, as a direct or contributing cause of death. This is not surprising when one considers the frequency of strangulation in neglected hernia,

especially of the femoral variety. Smith stated that the approximate number of deaths from various diseases in the United States per 100 000 of the population is as follows

Heart disease	2 67
Accidents	110 2
Hernia	100 0
Cancer	97 9
Pneumonia	94 0
Chronic nephritis	86 5
Cerebral hemorrhage	76 0
Tuberculosis	62 0

### Danger of Routine Hernia Operations

Colcord called attention to the risk attending the routine custom of certain companies in operating on all hernias occurring in their employees. He stated that in one patient operation was followed by dementia in another rapid tuberculosis and death resulted and in still another patient operation was followed by appendicitis and death. Although the hernia was not the cause of the conditions the appendicitis case got an award of death benefits and the other two were pending before the compensation boards.

### Medicolegal Responsibility in the Treatment of Hernia

The legal responsibility of the physician in the treatment of hernia is the same as that in general surgery and the reader is referred to special papers for detailed information especially to the articles by Carson and by Woodward and to the monograph of Regan.

The following brief summary of the legal rights and duties of physicians has been prepared by Mr. Robert J. Polome, General Counsel of the Illinois State Medical Society.

**Consent to Operation**—Before any serious operation the consent of the patient should be secured expressly (in writing if possible).

No right exists to operate against the will of the adult patient even to save life. In an emergency when the patient is not in condition to give consent and there is not time to communicate with those authorized to speak for him without gravely jeopardizing his life or health the law implies the consent of the patient.

A wife may determine whether or not she will be operated upon without her husband's consent.

In a case of a girl under eighteen years of age or a boy twenty-one the consent of the father is necessary; if he is dead the mother's consent must be secured. Consent of other relatives even if the child makes his home with them will not suffice if the parents live. In grave and pressing emergencies exceptions to this rule exist.

**Fees**—A corporation can be bound for an original engagement to treat an employee by promise of the president or general manager. A foreman, conductor, etc., has no authority.

Fees are impliedly to be paid by the patient if nothing is said upon the subject.

A person calling a physician to attend another is ordinarily not liable for fees

One having a child in charge is not liable from that fact alone as in case of grandparents with whom the child lives. In such case the father may become liable even though he has no knowledge the service is rendered. An original promise to pay fees, even if made by a stranger, is valid, if it is the basis for entry upon the case.

*Joint Liability*—Joint liability exists for acts of a partner in the course of partnership business. Assistants in the direct employ of a physician create liability for their wrongful acts.

The family doctor who calls in a specialist with assent of the patient is not liable for the negligence or unskillfulness of the specialist.

The operator who has charge of an operation is responsible for it. One who assists him is in clamping off blood vessels and sponging out, is not jointly liable for errors in performing the operation.

*Assistants*—Acts of assistants under immediate supervision of the surgeon are his acts in law if in his employ. Liability attaches for their acts within the scope of their duties.

Hospital attendants, internes and nurses furnished as working facilities by hospital authorities impose no liability on attending physician for their neglect except as such acts

1 Are directed by the physician

2 Occur in his presence

3 Are due to failure of the physician to give suitable directions

4 The physician fails to correct careless or unskilled conduct of which he knows or should know

*Contributory Negligence*—Contributory negligence of the patient may not bar his claim entirely. It depends upon whether his neglect to conform to instructions produces his entire infirmity or only a definable part of it. In the latter alternative it only lessens the amount of his recovery.

It is the general duty of a patient to follow reasonable instructions of the physician.

Consent preferably in writing must be secured before the hernia operation. Operation must not be undertaken on the side for which consent was not secured.

### Local Anesthesia

Local anesthesia is of especial advantage in case an additional operation is found to be needed after the one for hernia is begun. For instance when a hernia is discovered on the opposite side after intraabdominal examination when the appendix is found to be diseased and when resection of the cord or testis is indicated.

### Affidavit in Case of Atrophied Testicle

Claverley advised a routine examination of the testes previous to hernia operations. If the testicle on the side of the hernia is atrophied the patient should be required to sign an affidavit to that effect as a safeguard in case of litigation.

## Injection Treatment

In communities in which the injection method has not been employed, may not even be known, it is advisable for the surgeon who contemplates the use of it to discuss it with other doctors in his vicinity to familiarize them with it, so that if complications in the treatment should develop, he would not be charged with experimentation. This also applies to new hernia operations.

The advantages of the mild sclerosing solutions are particularly important because these mild solutions will have the least damaging effects if injected improperly.

The method must not be employed without sufficient preparation and experience in the technical details.

There is no doubt that surgeons who have employed this method for several years and treated many patients with it, will obtain better results than the novice. Mistaken diagnosis as to the type of hernia, and faulty technique have caused most of the failures and criticism of the injection treatment.

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